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A

# NEW SYSTEM OF CULTIVATION,

WITHOUT

LIME, OR DUNG, OR SUMMER FALLOWS,

AS PRACTICED AT

*Knowle-Farm, in the County of Sussex.*

BY

MAJOR-GENERAL ALEXANDER BEATSON,

LATE GOVERNOR OF THE ISLAND OF ST. HELENA,

AND

HONORARY MEMBER OF THE BOARD OF AGRICULTURE.

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"Petty operations, incessantly continued, in time surmount the greatest difficulties, and mountains are levelled, and oceans bounded, by the slender force of human beings."

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*Doctor Johnson.*

LONDON:

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1820.

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Il est même quelques cultivateurs qui sement leurs raves, leurs sarrasins, leurs veches, et autres grains, dont les produits remplacent ces *jachères*, sur de simples binages, ou même *hersages*, et qui obtiennent de suffisamment belles récoltes.

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Enfin, l'Agriculture de France, comme celle de tous les pays de monde, ne sera réellement arrivée à son plus haut point de perfection, lorsqu'avec le moins de dépense possible, on parviendra à obtenir, dans une même année, la plus forte masse de produits utiles, en ne laissant jamais la terre nue que dans quelques cas rares et forcés.

Nouveau Cours d'Agriculture.

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## P R E F A C E.

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It has often been lamented, that the attention of the Legislature has not been more alive to the improvement of Agriculture,—an art which has ever been considered the most important and most necessary to man—the surest basis of revenue and riches—and of national prosperity ; and without which no nation can flourish, or even exist.

The improvements, however, in this art, have been extremely slow ; and it is still very far from having attained perfection. Their progress has no doubt been checked or obstructed, in many parts of the kingdom, by the continuance of errors, which have been handed down through many ages. Had those errors been abolished, and proper remedies applied ; and had the farmers been fairly directed to the road which leads to the perfection of their art,—England would have become much more prosperous, and would have suffered but little distress or inconvenience,

from those unavoidable circumstances and events, that have unhappily been productive of the most injurious effects upon her agricultural concerns.

The situation of the cultivators, at the present time, is undoubtedly deserving the most serious attention. Their distresses are generally ascribed to excessive taxation, to high rents, to too great an issue of paper, and to a sudden transition from a state of war to peace.

But amongst all the causes of distress, it will be seen, by the following concise statement, that the most grievous, and the most ruinous to the agriculturist, is—the gradual transition from high to low prices ; a transition which presses more heavily upon him, than the whole of the other causes united.

In 1793, taxation amounted to 16 millions ; in 1804, to 34 ; and in 1814, to 60 millions sterling.

In 1793, the price of wheat was 48 shillings ; in 1804, it was 83 ; and in 1814, it was 101 shillings per quarter.

Supposing 10 millions of the population to have been supplied with 10 millions of quarters of home produce, in 1793 ; the value paid for wheat alone, in that year, at 48 shillings per quarter, was

	-	-	£24,000,000
In 1804, at 83 shillings	-		41,500,000
In 1814, at 101 ditto	-		50,500,000

Hence it appears, that the *same portion of land* which produced, in value, 24 millions sterling in 1793, yielded £50,500,000. in 1814.

This difference, of £26,500,000. was, to all intents and purposes, an *additional tax* on the consumers, and an *extra value* paid to the proprietors and cultivators, for this single article of farm produce: and as every article supplied from the lands had risen,—barley from 28 to 50 shillings—oats from 19 to 33—and all others nearly in the same proportion,—it may not therefore be too much to say, that the aggregate value received for farm productions in 1814, was at least 35 millions sterling *more* than were paid for the same articles in 1793!

Added to this, the population of the kingdom had to pay 44 millions of additional taxes; making, in all, a difference, or excess of burthens, of seventy-nine millions sterling, in the year 1814, beyond what they were in the year 1793.

The additional taxation fell chiefly on the higher ranks: but the augmentation of 26 millions in the value of wheat, although distributed equally, must have pressed very severely upon the labouring classes. It might easily be demonstrated, that a poor man, with his wife and two children, expended in the year 1814, from 40 to 60 per cent of his earnings in that one article;

whereas, the man of £2400. a year, having 20 in his family, consuming 20 quarters per annum, expended in 1793, not more than a fiftieth part of that income in wheat; and in 1814, about one twenty-fourth part. Hence, it is manifest, how necessary and important it is, for the comfort and happiness of the labouring classes, that *wheat*, the chief article of their subsistence, should be provided to them at the lowest possible price. It was stated in evidence before the House of Commons, in 1815, that if wheat fell in price, all other expenses might be expected to fall in proportion.

The real and true causes of distress may therefore be traced to the unnatural value to which land had risen, during a long period of war,—occasioned by an extraordinary demand for bread corn; and aggravated by the scarcities of 1800, 1, 10, 11, and 12; which, collectively, enhanced its price, from 48 to 101 shillings per quarter.

Many estates had been purchased and let, according to the scale of the higher prices. Now, that the prices of produce have fallen considerably, and high rents continued, it is no wonder that the situation of the cultivators should be greatly deteriorated; for it is very obvious, under the above circumstances, that their distresses must have increased, and will continue to in-



crease, precisely, in the inverse ratio of the decrease in the prices : unless some plan can be devised for removing the evils,—of which the cultivators have but too just reason to complain.

The author of these pages has attempted to shew, that such a plan is practicable ; and that it might be carried into effect, without any detriment to the landed interests,—by certain changes in the modes of cultivation—and by a rigid economy in all the operations of farming.

It is more than twelve years since he has devoted his attention to the most material branches of rural economy. The result of his practice was some time ago submitted to the consideration of the Board of Agriculture ; and they were pleased to desire him to furnish a Report upon the process and management. But, after having proceeded at some length in the task allotted to him, he perceived, that a dry statement of facts, and of farming operations, would be of little interest, and of little utility,—unless illustrated by observations and deductions, and by explaining the principles of his practice, and applying them to general purposes.

Moreover, the publication of Reports, or Communications, to the Board of Agriculture, is necessarily of a limited nature : and finding that

the subject gradually assumed a greater degree of importance the farther he advanced in it, he was, for all these reasons, induced to alter his original plan, and to lay the fruits of his labours and experience before the public, under a firm conviction, that amongst the various matters of which he has treated, something, at least, may be gathered, which may prove acceptable—and of utility, in advancing the art of Agriculture, and the general interests of the nation.

Thus, whilst he fulfils his promise to the Board of Agriculture, he has the gratification of performing a duty which every man owes to his country,—by endeavouring, as far as may be in his power, to promote the general welfare and happiness of the community.

*Knowle Farm, near Tunbridge-Wells,  
February, 1820.*

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## ERRATA.

Page 7, line 7,—omit, *in practice*.

46, Note,—“Tracts on St. Helena,” read *Dr. Johnson*.

68, line 22,—square of  $1\frac{1}{4}=2\frac{1}{4}$ , read  $1\frac{1}{2}\pm 2\frac{1}{4}$ .



# A NEW SYSTEM, &c.

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## I. ON MANURING LANDS.

*An important Fact ascertained by the Report of the Select Committee upon the Corn Trade. Suggestions for extending Agricultural Improvements. The dependence on Foreign supplies of Corn rapidly increasing. Expenses of cultivating Wheat reduced from £16. to £5. per acre. Agricultural Experiments in 1807, interrupted; continued at St. Helena; beneficial effects of, on that Island. Experiments resumed in England, with a view to economy in Manuring Lands; to the Abolition of Fallows; and to lessening the Charges of preparing the Soil for the Seed. Means of augmenting the value of Landed Property. Opposite Interests of Landlord and Tenant. Economy wanting in our Agricultural Systems—illustrated by the Sussex practice. Plans for lessening the heavy Expenses of Cultivation. Lime entirely abolished at Knowle-Farm. Abundance of cheap and excellent Manure obtained.*

It appears from the Report of the Select Committee of the House of Commons, appointed to inquire into the state of the Corn trade of the United Kingdoms, printed the 11th of May, 1813, “that in Great Britain the land now in tillage is capable of being made much more productive—and that upon the whole, it appears to be a fair

practical inference to draw from this inquiry, into the means which these countries possess of growing an additional quantity of corn; that they are able to produce as much more corn, in addition to that which they already grow, as would relieve them from the necessity of continuing in any degree dependent for a supply on foreign countries."

Thus far did the Committee proceed. They ascertained, after a long and minute investigation, the important fact, that, by the extension of an improved system of cultivation, the land now in tillage is capable of being made much more productive, and of yielding a sufficiency of corn for our population—. It does not appear, however, that any measure has been founded upon this important discovery, nor any means taken to explain the nature of the improved system, or to point out the method by which it is to be extended. The cultivators being thus left wholly to themselves, will naturally pursue their old and expensive practices—many of which, it is well known, are equally injurious to the interests of the government, as they are to those of the community; for it is upon the revenue and the consumer, much more than upon the landlord and tenant, that every unnecessary expense in cultivation must ultimately fall. Both these have their

remedy, the one by raising his rent, the other his prices : but there is no remedy for the consumer ; he must pay for what he requires, at whatever price the cultivator can afford to sell, and that price will be proportioned to the expenses of cultivation.

Hence, it is obvious, that the best—perhaps the only means of stimulating the exertions of the farmers, or of encouraging the extension of improved systems throughout the kingdom, would be to shew, practically, that the expenses of cultivation (upon which the value of land and the price of food depend) are capable of being reduced very much under what they are at present. This might be done, without any expense to the nation, if a few intelligent proprietors and farmers, in those counties where agriculture has undergone no change for many centuries, were to take the trouble of instituting comparative experiments upon a moderate scale, and of placing before the eyes of their tenants and others, examples of the most economical, and the most profitable modes of cultivation. Such examples would be of much more real utility in advancing the art of agriculture, than all the numerous volumes that have ever issued from the press. Had this method of instruction been adopted, immediately after the Report of the Committee,

the circumstances of this country might have been very different from what they are at the present moment. The agricultural distresses might have been effectually relieved; there might have been no necessity of continuing in any degree dependent for a supply on foreign countries; and the products of the soil, more especially bread corn, might have been furnished at a considerable reduction in the price, without any detriment to landlord or tenant.

The dependence on foreign supplies, it is lamentable to observe, is very rapidly increasing. In 1816, the value of imported corn, grain, meal, and flour, was £942,497.; in 1817, £6,403,893.; and in 1818, £10,908,140.! If by any means these sums could have been diverted into the pockets of the farmers (and which I firmly believe to have been physically practicable), there would have been no just cause at present of complaints, nor of petitions to Parliament on the subjects of agricultural and other distresses.

This opinion has not been hastily formed: it is the result of mature deliberation upon a variety of facts most accurately established during a long course of experience, and of minute attention to subjects connected with various branches of rural economy. Some idea may be formed of

the success which has attended my exertions in the abolition of unnecessary expenses in cultivation, and of the confidence I am warranted to place in the opinion I have just expressed, when I pledge myself to prove, by facts which are incontestible, that by the new system of cultivation I am now engaged in, I have effected a reduction in the charges of cultivating wheat, (or of preparing the land for the first crop of a rotation), to the amount of £10. or £11. per acre; or, in other words, each acre of my wheat costs not more than £5. including rent, taxes, seed, and all charges; whilst my neighbours, who adhere to the old Sussex husbandry, incur an expense of not less than £15. or £16. per acre.

In bringing forward a new system of cultivation, I am perfectly aware, notwithstanding such manifest proof of its superiority to the old, that many doubts will arise as to its general utility or advantage. In order, therefore, to obviate those doubts, or to remove them as much as possible, it becomes necessary to notice some of the circumstances that have progressively led to this new method of cultivation. By pursuing this course, I shall have an opportunity of shewing that I have proceeded with the utmost caution in every deviation I have made from the common practice; and that no alteration has been intro-

duced without having previously ascertained its efficacy and its superiority by the test of experiment ; and by applying it afterwards to an extensive scale of cultivation.

It is upwards of twelve years since I first turned my thoughts to farming. At first I consulted the best authors ; but on comparing them, there appeared so many contradictory opinions upon almost every material point, that I was soon convinced that the best and surest guide to agricultural knowledge, was through the medium of experiments. Books are, no doubt, useful for advancing the art, but they are far inferior to practice for conveying useful knowledge. Impressed with this opinion, I have relied mostly upon my fields for that sort of information I was in search of : I knew they could not mislead me ; and I knew, that what succeeded upon a small scale, was likely to answer upon a larger ; because, in both cases, there would be the same soil, the same climate, and the same influences of the atmosphere, all performing their several functions in the hidden processes of vegetation. Accordingly, I proceeded upon this plan, and resolved implicitly to follow the dictates of my own judgment, in ascertaining effects, without troubling myself with causes:

I made a beginning of experiments in 1807,

for the purpose of determining some contested points ; but they were scarcely begun when their progress was interrupted, by my appointment to the Government of St. Helena.

As I had formerly resided several months on that island, I was not unacquainted with the mode of cultivation ; and I foresaw that in practice there would be an ample field for continuing those pursuits in which I had just engaged. But, in attempting to introduce improvements where the arts of agriculture were (I may say) unknown ; “ where lands were cultivated by manual labour, without the aid of animals ; and where prejudices in favour of old customs were strong, it was obvious there could be no hope of amendment without the evidence of successful examples.”

“ It was therefore necessary to have recourse to experiments. Ploughs and other implements were provided by the Court of Directors ; the labouring population was increased by the introduction of about three hundred Chinese ; and after I had ascertained the capabilities of the soil, by a variety of small experiments, an improved system of husbandry was carried on, under the direction of an experienced Norfolk farmer. It was a long time before the generality of the islanders would even look at these improvements : they regarded them as ‘ mere

foolishness ;’ said ‘ they might do very well in England ; but, that in a mountainous country the plough could never answer ; that their forefathers had done very well with the hoe, and they saw no use or necessity for these new things.’

“ At length, however, when they perceived the facility with which extensive fields were broken up ; the rapidity with which they were prepared by the plough, and the excellent crops of potatoes and corn that were raised, they then acknowledged the superiority of English farming ; and many of the most respectable soon after followed the example.” \*

Thus, I firmly believe, it would be in these kingdoms, if the same pains were taken to instruct the farmers, and to draw them from their old customs, wherever they may be found defective, and adverse to the interests of the land proprietor, and to the national prosperity.

“ Besides giving examples in the use of the plough, and in the new culture of potatoes, and of corn, it was deemed proper to explain the principles, and to point out the advantages of the new husbandry. With this view, I prepared short agricultural essays (detailing the progress and results of the experiments), which were

\* Tracts on St. Helena, Preface, p. x.



printed for general information in the St. Helena Monthly Register." Thirty of these Essays were selected for the first part of the St. Helena Tracts, and published in England—because, it appeared to me, that many of the experiments, which I had conducted and superintended with the greatest care, are not undeserving the attention of British farmers; I allude particularly to those on the culture of potatoes and mangel wurzel—on green crops of oats or barley for feeding horses and cattle—on clearing lands of grubs—and on the beneficial effect of frequently stirring the soil, &c. &c.

Five years attention to these and many other agricultural subjects, and the complete success which attended my exertions, gave me reason to hope, when I returned to England in 1813, that I might employ my leisure, in retirement, with some prospect of advantage in my farming concerns: but beyond this object I did not aspire; because it had never entered my mind, that the schemes I was about to engage in, could have led to any thing so deserving the notice of a British farmer, as the plans of economy I have introduced in the cultivation of land—and which I shall now proceed to explain.

The experiments to which I have given my attention during the last five years, have been

directed to three very important points: *the abolition of fallows ; the manuring of lands at the cheapest rate ; and preparing them for the seed with the least possible exertion of animal strength.*

To enter into a detail of the experiments would carry me far beyond the bounds I propose for this report. Every field of my farm has been more or less an experiment field—containing sometimes two, or more ; and in one particularly, the combinations arising from different manures, from drilling and broad-casting, and from varying the quantities of manure and of seed, amounted to one hundred and twenty-eight ;\* each of which was a distinct and separate experiment. The results of some of these will be noticed, for the purpose of shewing on what grounds I had founded my expectations of success, before I ventured upon an extensive scale of cultivation.

At first the experiments were conducted upon a small scale, of one or two square rods to each. Although the comparisons which they afforded gave me sanguine hopes of success, yet some of the neighbouring farmers looked upon them with the utmost indifference ; they seemed determined not to be convinced that any mode could succeed

\* See Appendix.

upon their stiff lands but their own ; and when I ventured upon twenty acres of wheat, according to this new method of cultivation (I was informed), they considered me as wild and eccentric in my notions of farming. " How is it possible," said they, " that he can improve on our system, which has stood the test of many ages ? It is absurd to attempt it ; for had it been possible, the discovery would have been made many years ago."

Such were the sentiments and observations of my neighbours ; but I was not discouraged. One new scheme succeeded another, until the superiority of the whole system was manifested by the display of crops of wheat, by no means inferior to those which had been raised by fallowing and liming, at a threefold expense ; for mine cost not more than five pounds, whilst their's, as I have already stated, cost them at least fifteen or sixteen pounds per acre. This sort of evidence silenced all further remarks : and some of the farmers have since candidly acknowledged to myself that they never knew, until they witnessed this less expensive method of cultivation, the real value of their lands.

To encrease the value of land has indeed been the primary object of all my exertions. This, I conceived, could only be done by reducing the

expenses of cultivation ; for it is evident, that, inasmuch as those expenses can be depressed, so will the value of land be raised—consequently, every operation in farming ought to be conducted at the lowest possible charge.

It is very generally supposed that the interests of landlord and tenant are intimately connected : in some cases, however, they appear to differ extremely. The landlord must always feel an interest in improving the value of his land : but in this the tenant has no interest whatever. If improvements be made, he will naturally expect to be called upon for a higher rent : and this may explain his cold indifference to every species of improvement.

When a tenant takes a farm with all its incumbrances, of poor-rates and taxes, and of heavy expenses in cultivation, he calculates what rent he can afford to pay ; which must necessarily be low in proportion as those incumbrances are high, and *vice versa* ; so that rent, or the value of land, is, in many cases, regulated more by those incumbrances, proceeding from local circumstances and prejudices, and from the difficulty and expense of obtaining manure, than by any material difference in the quality of the soil.

Hence, it is of little consequence to the tenant, whether these incumbrances be high or low, as

his rent has been exactly adjusted by them : but to the proprietor the case is very different ; it is upon him, upon the revenue, and chiefly upon the community, that every unnecessary expense in cultivation falls. This was the opinion of Adam Smith, who says, that “ *whatever keeps down the produce of the land below what it would otherwise rise to, keeps down the great revenue of the people.* ”

If this be true, it will of course follow, that any measure which has for its object to raise the produce or the value of land, is deserving the most serious attention ; because, inasmuch as it may be found practically useful and successful, so would be the improvement of this great revenue of the people.

I have good reason to believe there are many farms, in their present state, of very little value—because the produce is kept much below what it might be, by such circumstances as I have mentioned : and that those farms might be made far more productive and profitable by certain changes in the mode of cultivation. Instead of that lavish expenditure for manure and labour, which is unfortunately but too prevalent—if the farmers were to strive by every possible means to obtain from their lands the largest quantity of the most useful and valuable productions, at the

least possible expense, the greatest improvements might be expected. This, in my humble opinion, comprises a general rule or principle, which ought never to be lost sight of, in our endeavours to improve our systems of agriculture. But this rule appears to be wholly unattended to in the unimproved districts, where a blind adherence to custom, and a strong belief that nothing can surpass the old practice, added to an indifference to all new schemes, continue to operate as formidable checks to every species of improvement.

In districts where laudable exertions have been made to improve, I think it will appear that greater attention might yet be paid to rural economy. Wonders, indeed, may be performed by powerful implements and abundance of manure ; or, in the words of Mr. Wimpey, “ amazing things may be done by dint of labour and expense ; but we are not enquiring after possibilities, but after what is really *the most profitable, and to be acquired at the least risk, and at the least expense.*”

This ought to be the criterion by which every new scheme of improvement should be judged. It should be submitted to the 'test of these short, but comprehensive rules. All the items of the expenses should be carefully examined ; and if

it appear, after defraying the whole, that the difference between them and the value of the produce (or the profit of the farmer) is *greater* than he had by his former practice, then he may safely adopt that which is obviously advantageous, and a real improvement: but on the contrary, if a smaller profit remain to the farmer, the fallacy of the plan is immediately detected, and it ought in this case to be wholly rejected.

There seems reason to suspect that some of our modern practices have not been submitted to such nicety of investigation, otherwise, it is scarcely possible, that the following remarks, which are but too applicable to the present time, could have found their way into so respectable a work as the *Encyclopedia Britannica*.

“Thus we see,” say the Editors, “that in the course of half a century, methods have been found out of eradicating weeds, destroying insects, saving vast quantities of seed corn, of suiting the crops to the soil, of using new manures, raising new plants, and all this, together with multitudes of new machines, for performing in a better manner the operations of agriculture, has apparently amounted to mere nothing. The price of provisions seems to have began to rise with the improvements, and to be continually advancing.” \*

\* Vide Husbandry.

This failure in the expectations of those eminent persons who have laboured in the cause of agriculture, and the slow progress that has been made in this most useful art (which is universally felt and acknowledged) seems to have proceeded from the causes I have already stated, and particularly, from the very heavy expenses incurred by those farmers who adhere to ruinous practices, that ought long since to have been abolished.

Some idea may be formed of the evil consequences arising from a waste of animal labour, and from expensive management, by the following detail of the process of cultivation, almost invariably practised in the vicinity of my farm. The lands are stiff, abounding with clay, retentive of surface moisture, but when dried by the summer heat, they become as hard as a brick, and are impervious to the plough, unless with a great power of animal exertion, particularly as the general mode is to plough deep.

The long established rotation in this part of Sussex, is, 1. Fallow and lime. 2. Wheat. 3. Oats. 4. Clover and ray-grass; and not unfrequently, during the fifth year, the clover and ray-grass remain.



*Charges of Cultivation.*

An acre of Clover lay prepared for Wheat.

	£.	s.	d.	£.	s.	d.
Breaking up the clover lay -	1	0	0			
2nd ploughing in May -	0	17	6			
3rd ditto in July -	0	17	6			
4th ditto in September or October	0	17	6			
	—	—	—	3	12	6
1½ waggon load of lime, between 3rd and 4th ploughing -	7	10	0			
Carting and spreading ditto -	0	6	0			
	—	—	—	7	16	0
6 harrowings after 3 first ploughings						
2 ditto after the 4th ploughing						
3 ditto after the seed is sown						
—						
11 harrowings, at 10 acres per day -	-	-	-	0	9	0
—						
Seed wheat 2½ bushels, at 10s. -	1	5	0	-	-	-
Sowing and rolling -	0	1	6			
	—	—	—	1	6	6
Rent for the year of fallow -	0	15	0			
Taxes for ditto -	0	15	0			
	—	—	—	1	10	0
Rent and taxes for the year of crop				1	10	
	—	—	—	—	—	—
Total expense per acre -				16	4	0

Labour, £4. 3s.—Manure, £7. 10s.—Loss of Rent and Taxes, £1. 10s.

During part of the time I was absent at St. Helena, my farm was managed according to this mode. Upon examining the accounts, it may well be imagined that I had no cause to boast of profit. I therefore resolved to look into the items of expense, and to trace the whole progress of the operations from the commencement of the

fallow to the close of a four or five years rotation. At present, however, for the sake of brevity and perspicuity, I shall confine these observations to the culture of wheat.

A statement, similar to that which has been just detailed, was made out according to the best information I could obtain, and which has since been verified by my own experience, and by the confession of every neighbouring farmer to whom I have shewn it. Therefore, £16. per acre may be taken as the actual charges of cultivation of lands which yield the proprietor no more than fifteen shillings ! The causes of so inadequate a rent, for land that will sometimes yield from £12. to £15. value in crop, I have already explained ; and the preceding statement most clearly proves, that the defects of this ancient husbandry\* are to be

\* The husbandry of this part of Sussex appears to have remained unaltered for many ages ; with the single exception of substituting lime for marle. This change took place about forty or fifty years ago ; when, by the improvements of high-ways, they became passable for waggons. There are many large marle pits in this neighbourhood : now but rarely resorted to. Hence, the charges of cultivation have been augmented, by the greater expense of lime, brought from a distance of twenty-two miles ; and by the more frequent application of it, than of marle, for the purpose of manuring the fallows.

attributed to the enormous expenses for labour and lime ; and to the addition of a year's rent and taxes for the year of fallow.

Seeing, therefore, that to continue such a course of cultivation would be attended with certain loss upon the wheat crop, I actually suspended my wheat culture for a whole year, and had resolved to abandon farming altogether, if I could not devise some other mode of cultivation far less expensive.

As a substitute for lime, I first tried Lord Meadowbank's compost of peat and dung, which produced a considerable effect. Afterwards, I

In other respects the husbandry seems to correspond with the practice at the period of the Norman invasion in 1066 : for at that period, we are told, " Summer fallowing of lands designed for wheat, and ploughing them several times, were practised by English farmers." Some traces of the Virgilian husbandry remain ; particularly the winnowing machine with sails.

The invasion of the Normans must have contributed very much to the improvement of agriculture ; as many thousands of husbandmen from Flanders, France, and Normandy settled in Britain and obtained estates, or farms, and cultivated them after the manner of their country. The implements used at this time were of the same kind as those employed at present : but some were less perfect in their construction. The plough, for example, had but one stilt, or handle ; and in Normandy it was drawn by *one* or *two* oxen. Their chief manure, next to dung, was marle.

burnt marle, conceiving, as it contained a portion of calcareous matter, that, by calcination, and proportioning the quantity laid upon an acre, it might produce a similar effect to lime. The effect of the burnt marle seemed to promise well, for, in the spring 1815, a top dressing having been laid on two acres of wheat, at the rate of 300 bushels per acre, the crop grew so high and exuberant, that a great part was laid by its own weight. I do not, however, consider this experiment as decisive of the effect of calcined marle. It seems probable that the ashes of the peat, with which the marle was burnt, may have contributed in a great measure to produce it.

I found considerable difficulty in burning the marle, in heaps or clamps, on account of its crumbling in pieces, and thereby choaking the fire. This rendered the operation expensive. Fortunately, just at the time I was engaged in these researches for a substitute for lime, a friend in Scotland sent me Mr. Craig's papers on the subject of burning clay.

Immediately upon receiving them, I constructed kilns according to his directions. The season being wet, with only short intervals of dry weather, I had great difficulty in drying the peat. Some of the kilns succeeded : but frequently I was disappointed by the dampness of the peat ;

and then my labour and expenses were entirely thrown away.

From the trials I had made of Mr. Craig's kilns, I perceived, when any thing went wrong in the beginning that there was no remedy, because there is no command over the fires after they are kindled. It therefore occurred, that to have the fires placed in such a manner as to admit of fresh supplies of fuel might be an improvement. By this means no disappointments could happen, and the operation of burning, could at all times, excepting in very wet weather, be carried on with a certainty of success.

Such are the kilns I have, for some time past, used ; but, as their form and construction will be described in another place, it is sufficient here to state that they have completely answered my expectations ; and that the expense of burning clay, or stiff soil, or marle, in them, is from tenpence halfpenny to a shilling per cart load of sixteen bushels.

Many experiments were made for ascertaining the efficacy of those calcined materials. Their effects were compared with those of lime, dung, raw marle, wood ashes, and peat and dung ; and after having satisfied myself that calcined clay, or soil, or marle, are equal, and in some instances proved superior, in effect, to any of those ma-

nures, I resolved to establish kilns in the most convenient situations, with a view to shortening the distances to which those materials are to be carried. I have at present four of those kilns which contain 800 cart loads, by which I could easily burn from 1600 to 2400 cart loads, or more, during the year. I have, therefore, a perfect command of an excellent and cheap manure, all over my farm, in readiness to be applied wherever it may be required ; and as the usual quantity laid upon an acre is only 20 cart loads, or 320 bushels, at each dressing, the cost of the material is not more than 20 shillings : whereas, by the use of lime, at the rate of  $1\frac{1}{2}$  waggon load, or 108 bushels, the expense, as already shewn, would be £7. 10s. per acre.

Having in this manner completely succeeded in obtaining the cheapest of all substitutes for lime or dung, I next turned my attention to the abolition of fallows, and to reducing the expences of labour in preparing the lands for the seed.

## II. ON THE ABOLITION OF FALLOWS.

*Fallows not necessary in the improved Husbandry—Ruinous Effects of; their Abolition would render the United Kingdoms independent of Foreign Supplies of Grain—Importance of the Subject—attended to in France and in the Netherlands—Plans suggested for an entire Abolition—Symptoms of a Change in the Old Husbandry—Remarkable Contrast in a Crop manured with Dung, and calcined Clay—Drill Husbandry recommended—A new Mode of Row Culture, without using a Drill.*

“THE practice of fallowing,” says the author of the New Farmer’s Calendar, “the miserable substitute of former times for manure and the hoe culture, can no longer be necessary on any soils under the improved state of husbandry.” Although I entirely concur in this opinion, and have wholly abolished fallows on my own lands, yet, as they are considered indispensable in the broadcast husbandry, for the purpose of eradicating weeds, mellowing the soil, and obtaining pulverization, I shall offer a few remarks on this particular branch of husbandry, which I consider one of the principal causes of “*keeping down the produce of land below what it would otherwise rise to.*”

It is well known that every farmer who

fallows, pays a year's rent and taxes for a portion of his land, that is to remain unproductive for that year ; and that the preparation for the crop is the most laborious and most expensive of all his operations. This, however, I have already shewn, is of little consequence to the farmer : the charge falls upon the land-proprietor, the revenue, and the community at large ; and the general effect of the fallowing system is, to diminish the produce of the land throughout the kingdom at least one-fifth under what it would be, if the fallowed acres were made productive, and added to those which are now annually in cultivation.

This addition would be more than sufficient to render these kingdoms fully competent to supply with bread corn the present population, without breaking up new lands ; which would require a vast application of capital that might in other enterprises be more profitably employed, unless means can be devised (as I am of opinion they might) for introducing more economical and more profitable systems of husbandry, than those which are at present very generally adopted.

Every means ought therefore to be attempted to banish so absurd a practice from all our systems. Already there are many decisive proofs in



our own country, in Flanders, in Switzerland, and in France, of the successful abolition of fallows. In France, particularly, great efforts are making to root out a practice, which is considered "*destructive de tout espèce de prospérité mais bientôt* (says M. Yvart) *nous devons espérer d'arriver successivement à l'abolition de la Jachère absolue, sur le territoire Français parcequ'un grand nombre de cultivateurs zélés et instruits, osant braver tous les obstacles que leur opposent la routine et les préjugés, donnent à leurs voisins d'utiles exemples qu'ils ne pourront manquer d'imiter.*"

Sir John Sinclair, in his Hints on the Agriculture of the Netherlands, has communicated some facts that are well deserving the attention of those who still contend for the necessity of fallows. He informs us, that "after a considerable struggle," they have been almost abolished in the plain of Fleurus ; and that the Swiss farmers have entirely abolished them. It would be fortunate for the community, and for our agriculturists themselves, if such examples were imitated in every part of the United Kingdoms.

The Society of Agriculture at Boulogne-sur-mer, (as appears by a Procès verbal of their sitting on the 24th of May, 1819), after adverting to fallows, and the great disadvantage of keeping

one-third of the lands unproductive every year, which is the practice in that part of France, have offered a premium for the best memoir upon the net produce from a three years course of lands of the same quality kept in fallow, and from those where fallows have been abolished.\* Encouragement of this sort may be of use in removing prejudices in favour of long established customs; but, in my own opinion, a more effectual mode would be, to institute *small experiments* throughout the kingdom, for the purpose of determining this, and every other disputed point in agriculture. This could be done at a mere trifle of expense to the land proprietors who may undertake them. Some of my most valuable experiments were made on spaces of only a rod square to each. Upon this small extent may be ascertained, with sufficient accuracy for any practical purpose, the relative effects of a

\* Sir John Sinclair states, that it has been ascertained in Flanders, that after a fallow, wheat produces at the rate of only  $12\frac{1}{2}$  per seed; whereas its produce, after rape or colsat, is  $13\frac{1}{2}$ , and that the crop is not so liable to be affected by the mildew." Hitherto my best crops of wheat have succeeded winter tares. This has induced me to adopt the rotation of, 1. *Tares*. 2. *Wheat*. 3. *Oats*. 4. *Clover and ray Grass*. The tares are manured—and the wheat stubble being burnt with a small portion of the soil, cleans and prepares the land for the oats and grasses.]

fallow or no fallow—of deep or shallow ploughings—of cloddy surface or fine pulverization—of one stirring or of frequent stirrings of the soil—of thick or thin sowing, and of all the various sorts of manure, within reach of the estates upon which those experiments may be made. In short, I know from twelve years experience, that there is no point in practical agriculture which could not be decided in this manner—without entering into long, and sometimes angry discussions, which only serve to tire and perplex those who read them.

I have often been asked—“Has your mode of farming been adopted? Do the farmers come into it?” The answer is obvious—that a farmer has no inducement to adopt new plans, and therefore is perfectly satisfied with the old.—Besides, under the condition of the leases, however much he may be convinced of the advantages of a new method, or however desirous he may be of imitation, he dare not attempt it—he must adhere to fallows—to lime, and to the whole expensive routine laid down for him: otherwise he is liable to certain penalties expressed in the lease.\*

\* Some farmers, or rather small proprietors, who reside at a distance, having heard of my mode of farming and of burning clay, visited my farm some months ago. I readily

I have already noticed that fallowing of land is considered indispensable in the broad-cast husbandry—and possibly it may be so in some particular cases, where that mode of husbandry is prac-

gave them every information they desired,—and, convinced as they were of the ruinous expenses, of lime, and of the cheapness of my mode of management, they have made a beginning in burning clay. One of them, Mr. Gibeon Jarvis, whose farm I visited, in the parish of Ticehurst, gave me the following particulars of his intended experiments.

He burnt, in a heap, 241 cart loads of very stiff soil, mixed with grass and other vegetable matter. For the labour of digging and burning, he paid a shilling per cart load of 14 bushels—or £12..1. The fuel consisted of three cords of roots, in a rough state, which he estimates at 18 shillings; and 25 kiln faggots at 2 shillings—so that the total cost of the 241 cart loads was £13..1.—or 13 pence per cart load.

These 241 cart loads were spread, at the rate of 54 loads per acre, upon rather more than 4 acres. Upon  $1\frac{1}{2}$  acre he spread  $1\frac{1}{2}$  load of lime—and the western part of this field of 10 acres, has been manured with a compost of dung and mould, at the rate of 40 of the above cart loads to the acre. Between these several manures he has left unmanured spaces. These experiments are arranged with judgment. I have no doubt, if he has well pulverized the soil and the clay ashes, that the results will be satisfactory, not only from my own experience, but from a comparison made by Baden Powell, Esq. of Langton, who, last year, manured one-half of a field of wheat with lime, and the other with burnt clay. When he viewed this field, just before the crop was reaped.

tised : but, it seems to me, if it were conducted in a different manner—if dung were seldom permitted to be put on arable land for corn crops—if burnt clay, or marle, or soil, were substituted for lime ; and, if the stubble of every corn, tare, bean, or pea-crop, preceding the wheat or any other crop, were loosened by baulk-ploughing and scarifying, and afterwards raked with a portion of the soil, containing the roots and seeds of weeds, and the whole burnt in the manner I practise in my new husbandry, I am of opinion, that by these easy means, which effectually clean the land, and produce a finer pulverization—even in the broad-cast system, fallowing might be dispensed with. This opinion is founded upon many proofs I have had of the extreme cleanliness of those fields, and the very fine pulverization of the soil, where those operations have been performed, and the calcined materials laid.

In a small field of wheat, where I had four

it was equally good throughout,—no difference whatever was perceptible.

The success of the Ticehurst farmer would soon establish the general use of burnt clay, or soil, instead of lime, throughout his neighbourhood—which would tend greatly to improve the condition of the farmer ; provided the land proprietors will sanction this change in the Sussex husbandry.

burnt clay experiments, around which was a space unmanured, and beyond it, all the rest of the field manured with rot dung, at the rate of forty cart loads per acre, and the whole scarified, harrowed, and drilled, exactly in the same manner — those clay experiments maintained a very striking superiority, during the growth of three successive crops: the first was a mixture of oats and tares; and the second and third were wheat.

At the time of reaping the wheat this year, the four experiments, which had respectively at the rate of ten, twenty, thirty, and forty cart loads of clay ashes per acre, were all greatly superior in produce, and perfectly clean and free from weeds, whilst the dunged part was absolutely choaked with knot and other grasses, and vastly inferior in produce, although the whole had been twice hoed during the growth of the crop. So very foul was the dunged part, when the crop was reaped, that each sheaf appeared to consist of, at least, a quarter part of those grasses, and weeds.\* Fortunately, this was but

\* “Two very considerable and respectable farmers observed, that if they manured their lands, they must necessarily introduce *with their dung the seeds of weeds*. Three years ago I saw such a sight in a certain part of the famous county of Kent, as I scarcely ever witnessed even under the

a small patch of two acres ; it was the only dunged part of fifty acres of wheat, and the only field that was this year infested with these grasses and weeds.

old farming school. It was a piece of wheat coming into ear, in which the weeds were so much the greater and taller, that they appeared the proper crop, and the wheat neglected weeds. And I have lately been informed that in a certain fine county, there are many examples, where the land is so entirely filled and choaked with couch grass, and weeds of every species, as to obstruct the plough, indeed to render ploughing so difficult, that the farmers rather choose to drag in their seed," *New Farmer's Calendar*, p. 613.

It seems to me that the best mode of cleaning land so extremely foul as that alluded to in the above extract, would be to scarify, and rake, and burn, in the manner that has been described. This would be much more effectual than a summer fallow, conducted as it generally is by burying the seeds of those grasses and weeds, and raising large clods. If indeed the fallow were entirely worked by the scarifiers, by which the land would at once be brought into a fine state of pulverization, in this case, as every seed would be loosened from the soil, there would spring up an abundant crop of young weeds, which could easily be destroyed during the summer months, by passing the scarifier once or twice over the land, at a time when the weather is dry and warm. The whole of those young plants would by these means be withered and destroyed, and the soil, by being thus open, and porous, would be in a proper condition for receiving a copious supply of all the rich and nutritious principles of vegetation, with which the atmosphere abounds.

I ascribe the extreme foulness of this dunged wheat, to the farm yard having been littered with fern, and those grasses ; and to this litter not having been sufficiently rotted, at the time it was carried to the land.

The general introduction of the drill husbandry, would undoubtedly be the most effectual method of getting rid of the heavy expenses of fallows, and of all their attendant evils ; but, as this can hardly be expected on account of the existing prejudices against drilling, from an idea that it is troublesome and expensive, it would certainly be conducive to the interests of agriculture, if this abolition could be brought about by some other means.

In addition to the method already suggested for attaining all the ends proposed by the summer fallow, at a very trifling expense, there is another method which has lately occurred in contemplating this very important subject. It is simply this—to meet the broadcasters half way, to allow them to sow the seed in the usual manner, and immediately afterwards, without harrowing, to throw the seed in ridges, or rows, nine inches or more apart. This mode I have lately practised upon a field of nine acres, with an implement having four shares, which raises the seed and soil vertically, and then laps them over



to the right and left, so as entirely to deposit and cover the seed to the depth of two or three inches. This machine will be more particularly explained, when I describe the other implements made use of in my present mode of cultivation.

It seems probable, that by such means, almost all the advantages of the drill machine are attainable. The seed is more completely covered at one operation, than with three or four harrowings; and being placed in rows, the crop would have the advantage of more air, a greater freedom for the lateral roots, and there would be a greater facility for hand-weeding, even if the rows did not admit of horse-hoeing between them; which is a point that remains to be ascertained.

I have long considered that the entire abolition of fallows is absolutely necessary, if we ever expect to attain perfection in agriculture, or to render this country *a great agricultural country*, which in my humble opinion it might be, if proper means were adopted for correcting existing errors and mismanagement; and for introducing a general system of economy and improvement throughout the kingdom.

That fallows were practised in the early ages, is certainly no argument for their continuance at the present time, when we have abundance of

facts to prove that they can well be dispensed with. Their continuance, under such circumstances, can therefore only be ascribed to that unaccountable bias, and prejudice, which we observe towards many other customs that have been long established.

Sir John Sinclair is inclined to believe, from what he was informed, and saw in Flanders, that fallows are not necessary even on strong lands, if they can otherwise be cleaned and pulverized. That this cleaning and pulverization are perfectly practicable, even on the strongest and stiffest lands, will I hope be satisfactorily demonstrated in the following Section.

By the entire abolition of fallows, two millions four hundred thousand acres,\* in England and Scotland, of equally good lands as the other parts of the farms, would immediately be brought into cultivation without any additional capital, or any additional expense whatever ; on the contrary, I have not the least doubt of proving by my own experience, that the expense of

\* "There are in England about 2,200,000 acres in fallow every year, and 200,000, in Scotland." (Sir John Sinclair's *Hints on the Netherlands*, Pref. 1815.) The writer of the *Survey of Middlesex* states that there are about nine millions of acres in England and Wales under the course of two crops and a fallow,—i. e. six in crop, and *three millions in fallow*.

cropping the fallowed lands would even be less than is at present incurred, by keeping them unproductive of any thing, excepting that waste and extravagance I have already noticed,

How very different is all this from those plans of bringing waste lands into cultivation : a measure considered indispensable in almost every project that has been brought forward for procuring an independent supply of food for our population. What a prodigious capital would be necessary for rendering a similar extent of waste land productive : for defraying the charges of new buildings and inclosures, and for providing additional stock for so great a number of new farms ! Rating those charges at only £20. per acre, the capital that would be required to be sunk would amount to at least *forty eight millions* : whereas, by the entire abolition of fallows, this sum would in a manner be added to the great fund or capital of the kingdom, without any expense whatever.

But this is not all : many other obvious advantages would accrue from the proposed abolition. Provisions of all sorts would become more abundant and cheap, which would tend greatly to the comfort of the labouring classes, and to a considerable reduction in the poor rates ; much less labour and expense would be required to

make the fallowed lands productive, than to give them, for a whole year, the usual tedious and expensive preparation. In the next Section I propose to illustrate this by examples—and I shall there shew in what manner the farmers in my vicinity lavish the labour of twenty horses for one day in preparing each acre of their fallows for wheat : whilst I obtain absolutely a more perfect pulverization, and crops equally good, without a fallow, and with the labour of only five horses for one day : and in some cases with even a less number.

Upon the whole, I think that this concise view will be sufficient to give a correct idea of the immense advantages that would flow from a total abolition of fallows ; and, as it is a subject most intimately connected with the two grand principles of political economy, that of augmenting the revenue, and providing food for the population, I am not without hopes it may attract the particular notice and attention of His Majesty's government ; and that some measures may speedily be adopted for putting down *opinions*, and a ruinous practice totally at variance with positive and incontrovertible facts.\* To

\* One of the best essays on the subject of the abolition of fallows I have yet met with, is in a work entitled *Nouveau Cours complet d'Agriculture Théoretique et Pratique* ;

be convinced of this, we have only to look into the Annals of Agriculture—and we shall find abundant evidence of the successful abolition of fallows upon every description of soil ; particularly by the improvements of Bakewell, Arbuthnot and others. Let the examples before us, become general, and there will soon be a vast amelioration in the agricultral circumstances of these kingdoms.

Upon the means of effecting so desirable a change, I have already offered a few observations ; and I stated my opinion, *that the institution of small experiments throughout the kingdom, under the superintendence of the land proprietors, (who are undoubtedly persons much interested)*—appeared to me as likely to be the most easy, the least expensive, and the most effectual.

published in 1809. M. Yvert, a professor of agriculture and rural economy, has treated the subject in so able a manner, and has adduced so many proofs of the successful abolition of fallows, in France, that I am of opinion if the whole of the article *Jachère*, were translated into English, and printed for general information, it could not fail to convince the fallowists that the system is wholly unnecessary, attended with enormous expense, and ruinous to their own as well as the public interests.

### III. ON PREPARING THE LAND FOR THE SEED.

*An easy and expeditious Method of obtaining a more perfect Pulverization, than by Ploughs and Harrows.—Observations on deep and frequent Ploughings.—More exertion of Animal power required in ploughing at once deep, than by repeating the Operation twice, to obtain the same depth.—New Implements adopted.—The requisite power to prepare Land greatly diminished.—Concise description of the Implements.—The daily Effect of each Implement—and the daily Expense of each Operation.—The whole illustrated by practical Examples.*

HAVING detailed the methods by which I have been relieved from two very expensive charges incident to the old husbandry, (liming and fallowing), I shall now proceed to explain the alterations I have introduced for preparing the land, — by which I can easily and expeditiously obtain a more minute division of the particles of the soil than can be produced by the plough and harrow. Instead of waiting from harvest until the following seed time, and wasting, as my neighbours do, the labour of my teams in ploughing, and reploughing unproductive land, I prepare for the winter sowing, and have the fields appropriated to wheat, and winter tares, all in readiness for the seed, in the course of a few

weeks after the preceding crops have been removed. This I am enabled to do by using the plough very sparingly, and sometimes not at all.

All writers on husbandry, from the days of Columella\* to the present time, have strongly urged, and some have practically proved, the great advantages of a perfect pulverization of the soil. The general principle which they inculcate is, “*to keep the lands clean, and in fine*

\* Columella advises that the soil should be reduced to dust by ploughing; and he quotes a saying of the ancient Romans, that *land is ill ploughed which wants harrowing after the seed is sown*. With implements of less power than those in use at the present time, this extreme fineness is attainable without harrowing: but whilst the practice of tearing up large clods continues, not only harrowing, but frequent rollings will be required, to reduce the soil to that degree of fineness which is recommended. By that practice, (which is unknown among eastern nations, and must have been unknown in England, when only one or two oxen were used in a plough), a foundation is laid for an immensity of future labour, which might be avoided, if less powerful implements were used; and if we were to imitate the Chinese and Indians, by *ploughing and pulverizing at the same time*, which their slender implements compel them to do, and which may be more effectually performed by scarifiers. These, in fact, (as will be shewn) perform at once the double office of plough and harrow, and, I may add, of the roller—because when land is prepared simply by the scarifiers, no rolling is wanted.

*tillth, and to make a farm resemble a garden as near as possible."*

Although every man of the least reflection must be sensible that this garden-like culture is much better than that of the field, yet we find many advocates for a rough cloddy surface, who practise in the field that which they never dream of in their gardens. If those persons were to try an experiment of the two modes in a garden, or in a field, they would soon see the vast superiority of a fine pulverization. For my own part, I have, in so many instances, experienced this superiority, that I am rather in doubt whether a considerable share of the effect of the calcined materials has not been produced by the extreme fineness to which the soil is reduced by *implements of small power*—and therefore I have spared no pains to discover by what means I could obtain this minute division of the particles, at the least possible expense.

In my endeavours for the attainment of this object, I soon perceived, that, by the usual mode of *deep and frequent ploughings*, there was scarcely a possibility of reducing strong clayey lands, such as mine, to that degree of fineness required for the drill. A respectable and intelligent landholder in this neighbourhood, when I mentioned to him my intention of practising the



drill-husbandry, told me “ it would not do—he had given it a trial—and gave it up, because he could never get his land fine enough.”

After considering what might be the cause of this failure, I inferred that those deep and frequent ploughings were injudicious : too much was attempted at one operation ; that the first ploughing not only buried the seeds of weeds beyond recovery, which had fallen on the upper surface, but brought up immense slags—which being cut transversely by the second ploughing, left the field covered with huge clods, in which were securely locked up some of those seeds which had no chance of vegetating until the close of the fallow ; consequently their progeny, which it was intended by the fallow to destroy, would have equally the benefit of all these laborious and expensive operations of the fallow, and of the manure, as the wheat itself—and would grow with it, and rob it of a part of that nourishment, which it would have had, if those robbers of the soil had been destroyed before they came into existence ; or as soon as they shewed themselves. The best mode of bringing them forward for the purposes of destruction, is to loosen them from their prisons, and to destroy them by fire in their embryo state ; and to give those which may have escaped, some

chance of vegetating by a fine tilth, before the crops are put in the ground.

But to obtain this requisite fineness of tilth in an easy and expeditious manner, appeared, at first, a matter of some difficulty. I had at this time a field of five acres, which had remained in fallow five months. It had received only one ploughing, and had no manure after the four preceding crops. Early in March I was about to prepare it for oats. I was advised to plough it; but as the slags were at that time as hard as a brick, it was very evident that the whole surface would be immediately converted from smooth slags into large clods—which it would be almost impracticable to reduce by any means—unless they were a little softened by rain: moreover, I conceived, that by ploughing at this time, a raw unmellowed soil would be brought up, and the surface, which had so long been exposed to the beneficial influences of the atmosphere, would be buried; so that the advantage it had gained by that long exposure, would be almost entirely lost.

For these reasons I resolved to pulverize the slags by other means. It was a work of great labour; for I had at that time no other suitable implement than the brake, or heavy harrow. At length, however, I succeeded, after five days

labour, of eight oxen and one horse to the brake, and two horses to a pair of harrows, in reducing this stubborn field almost to dust. The expense of man and cattle labour was 31 shillings per acre.

The oats were sown broad-cast, and yielded as fine a crop as was then to be seen in this neighbourhood, to the surprise of some of the farmers, who predicted, that as the land had not been manured, it would not yield even the quantity of seed sown.

So manifest a proof of the beneficial effect of a fine pulverization, determined me to try if some means could not be devised for obtaining it at a less expense.

In preparing this oat-field, I had at first used the brake merely by dragging it in the usual manner. Afterwards it was equipped with two stilts, or handles, which gave it greater power: but I observed when the hindermost tines were inserted in the soil by the pressure on the handles (by the man who held and directed the brake), many of the foremost were thrown out, and consequently had no effect.

It was then I first perceived the imperfection of this implement; and that however effectual it may be on light soils, it is not adapted to the heavier sorts. This imperfection arises from there being too many tines, or points of resistance, interfering one with another. In general,

the number is thirty-six—which are in fact so many resting points—bearing the whole weight of the implement.

Now, if we suppose this whole weight to be 720 pounds, the weight on each tine will be no more than 20 pounds, which can produce but little effect on any hard surface. To increase this weight (or power) on the tines, it was only necessary to reduce their number. It is upon this principle I have constructed my small scarifiers. They have no more than seven tines, inserted nine inches apart, upon two parallel lines, at the distance of 15 inches, by which the power is not only more concentrated, but very greatly augmented; for, if we suppose the same weight, of 720 pounds, acting or pressing upon those seven tines, it is evident that, instead of 20 pounds, the force, or pressure, on each tine will be  $102\frac{2}{7}$  pounds, or one-seventh of 720.

As one of these improved scarifiers, with a single horse, appears to me to produce, at one operation, as much effect as four or five Indian ploughs, or the same number of Chinese ploughs, I have been induced to enquire a little into the construction and application of these slender implements, and to examine, as far as I have at present the means, the *surprising* performances of the Chinese plough.

Of this implement there is a very good repre-

sensation in the Farmer's Magazine for 1805, described in a letter to Lord Somerville. The anonymous writer states, "it is so light, that a man can easily carry it on his shoulder. The ploughman manages it with great ease with one hand. On light soils, one bullock, the size of a small Highland cow, is used. On the clay soils, which, about Canton, are like our carses (and which they always plough wet), they use a buffalo, being stronger. I assure you," says this writer, "that a Chinese ploughman would laugh as heartily at Small's plough with two horses, as a Lothian farmer would at the clumsy machine with six horses, used in this neighbourhood."\*

The Indian plough is, I think, of lighter construction than the Chinese. I have seen an Indian returning from his day labour, seated on a small bullock, gaily trotting home with his two ploughs, one in each hand, resting upon his thighs. The sight was so remarkably striking, that I did not omit at the moment to give it an entry in my journal.

But, as Doctor Johnson observes, "*All the performances of human art, at which we look with praise or wonder, are instances of the resistless force of perseverance.*" It is not by a single operation, that the Chinese and Indian ploughs

\* Blackheath.

perform those wonders which have attracted the notice of travellers—this would be utterly impossible ; for neither the strength of the implement, nor the power of the two miserable animals that drag it, would admit of so much exertion, as would be necessary at once to penetrate the soil to the requisite depth, unless in a rice field, which is, by water, converted to a perfect puddle. The whole secret consists in—*petty operations incessantly continued* ; which, “ *in time, surmount the greatest difficulties.*” \* When I was at St. Helena, I sent for Chinese and Indian ploughs, intending to introduce them on that island ; but when they arrived, I looked upon them, as most people of this country would, with not very favourable impressions. I therefore gave a preference to the Norfolk plough, because, at that time, I was not aware of the necessity of repeating those petty operations.

Doctor Buchanan, in the account of his journey from Madras through *Mysore, Canara, and Malabar*, gives the following notices respecting the repetition of ploughings, and the *imperfection* of the plough's used in those countries. “ On considering the state of agriculture near Serin-gapatam, many capital defects will be perceived. Owing to the extreme imperfection of imple-

\* Tracts on St. Helena.

ments, and want of strength in their cattle, a field, after *six or eight* ploughings, has numerous small *bushes* remaining as upright in it as before the labour commenced—while the plough has not penetrated above three inches deep, and has turned over no part of the soil. The plough has neither coulter nor mould-board, to divide and turn over the soil ; and the handle gives the ploughman very little power to command its direction. The other implements are equally imperfect, and are more rudely formed than it was possible for my draughtsman to represent.” Vol. I. page 127.

“ For the *Carteeka* crop (of rice) five ploughings are given: after the fifth ploughing the field is manured and ploughed again twice.” Vol. III. page 143.

In preparing the dry land for raggy (or *Cynosurus Coracanus*), which is called in India a dry grain, because it is cultivated on dry land, Doctor Buchanan gives the following account. “ The ploughing commences whenever the first occasional showers in spring have softened the soil sufficiently to receive the plough. From that period to the 5th of June the field is ploughed from four to six times, according as it may be found clean or foul. The dung is then given and ploughed into the soil.” Vol. I. page 100.

“ For *Navara* rice the field is ploughed ten times.” Vol. II. page 374.

These notices will be sufficient to shew, that in the culture of wet as well as dry land, there is a repetition of ploughings, which may well be imagined to be absolutely necessary when the construction of the Indian plough is considered. Some idea may be formed of them by the representations given in Plate IV. These are copied from Doctor Buchanan's work, and are reduced to the scale of the implements in the Plates I. and II. for the purpose of exhibiting their relative dimensions compared with those of an English plough, as in fig. 3, and of the several implements used in my new husbandry.

Doctor Buchanan has said, that the Indian ploughs have neither *coulter* nor mould-board. This appears to be rather incorrect, because the points of all those ploughs which enter the soil have much more the resemblance of coulters than of *shares*; not only from their being narrow, but from their vertical position, or the angle which they form with the beam. It is obvious, however, that the intent of those implements is merely to break and crumble the soil without turning it. This is precisely the effect produced by scarifiers or harrows, which I conceive to be all that is required: and this effect can



certainly be much more easily produced, than when to the breaking or crumbling, are super-added the heavy operations of *ploughing deep* and *turning*. If, however, the latter operation were actually necessary (and I knew no reason why it should be so considered), the implement 5, in Plate II. will perform it as effectually as any mould-board plough, (*after the pulverization of the soil is completed,*) at the rate of three acres per day, with only one horse.

I cannot conclude these remarks without adding, that notwithstanding the seemingly imperfect construction of Indian ploughs, the farmers manage to produce excellent crops of all sorts of grain. Their rice or paddy, yields from 33.3 to 66.6 bushels per acre, and their wheat, called *Javi Godi* (or *Triticum Monococcum*) from 22.2 to 26.6 bushels per acre.

During my surveys on the Peninsula of India, extending from Cape Comorin to the Godavery river, and as far westward as Seringapatam, I had opportunities of observing many thousand acres of crops as perfectly clean, and as free from weeds and bushes, as those in the best cultivated counties in England. The bushes alluded to in the first of the preceding extracts from Doctor Buchanan's work, are (I am credibly informed) left *untouched* by the plough, from a superstitious

eneration to a practice handed down through many ages. They are not occasioned by the imperfection of Indian ploughs, which, I am disposed to think, have more perfection than travellers have allowed them. We ought to judge by the *effects*, and not by the *appearance*, of those rude, and, apparently, imperfect implements.

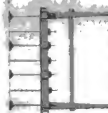
If we apply the principle of petty operations to any stiff land—by taking that depth of furrow which can easily be ploughed with *two* horses, and repeat the operation, (or plough the land a second time) we shall arrive at the end proposed, that is, the same depth of ploughing, with absolutely less exertion of animal strength, than if we were to plough the *same* depth with *four* horses at one operation.

This may be illustrated, by supposing the resistances to the plough to be in proportion to the squares of the depths of the land. If so, and we are to plough, at once with four horses, six inches deep, the resistance at that depth would be  $6 \times 6 = 36$ : but, if with the same four horses, using two at a time, we plough the same depth of six inches at two operations, taking only three inches at each, then the square of the first depth is nine, and the square of the second, nine—making 18—for the total resistance, or the power



SCARIFIER & HORSE HOE.

*Drawn by one horse — it scarifies or hoes three acres per day.*



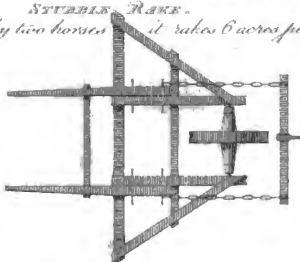
*Elevation*

*When used as a scarifier the three coulter lines 1, 2, 3 are placed opposite to the intervals of the four shares on the pend bar, but when used as a horse hoe there are four coulters opposite to the four shares.*



STUBBLE RAKE.

*Drawn by two horses — it rakes 6 acres per day.*



*Elevation*

MARKING and WARPING

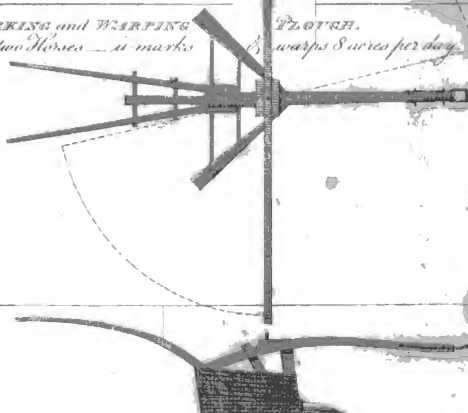
*Drawn by two horses — it marks*

PLOUGH.

*warps 8 acres per day.*



*Elevation*



expended by the two horses in ploughing six inches deep at two operations.

Moreover, if we take the depth of only three inches instead of six, it is evident the slags, by being only half the thickness, must be in a much better state of preparation for the harrows and roller; and their effect upon them will be proportionally greater, in reducing them to the requisite degree of fineness.

But in the methods I have adopted for attaining a minute division of the particles of soil, the plough is but little used, and sometimes not at all. The chief use to which it is applied is in baulk-ploughing, with two horses, at the rate of three acres per day with one plough—furrows, 27 inches apart, and about four inches deep, are opened all over the field, which prepare them for the small scarifiers.\* These, by twice passing across those furrows, loosen all the stubble and roots of weeds, which are afterwards collected with a small portion of the soil, by a rake six feet in length (Fig. 2, Plate 1.), drawn by two horses. At favourable opportunities, when the weather is dry, the whole of this rubbish is placed in heaps, 33 feet, or 11 paces asunder,

\* I have lately ascertained that baulk-ploughing is unnecessary. The scarifiers are, in most cases, sufficient for pulverizing the soil. This will be explained.

and the stubble being laid on the windward side, and kindled, the flame acts with nearly the force of a blow-pipe, and speedily reduces the whole to ashes. By arranging the heaps at the distance of two rods, it becomes easy to compute the quantity of ashes thus obtained per acre.\* The ashes are spread as soon as possible, and the land is again twice scarified (and sometimes once harrowed afterwards), which completes the pulverization, and renders the soil in a fine condition for receiving the seed.

This mode of preparing the land, (as will presently be shewn), does not require more than *one-fourth* of the animal labour which is usually applied by the neighbouring farmers in working their summer fallows, and completing their seed time.

Their practice is to give four ploughings to the fallows ; and it is supposed they can accomplish an acre in a day. Now, as each ploughing is performed with four horses, it is evident that the power of 16 horses for one day is expended in these four ploughings of each acre ; and, if we rate the harrowings and rollings, &c.

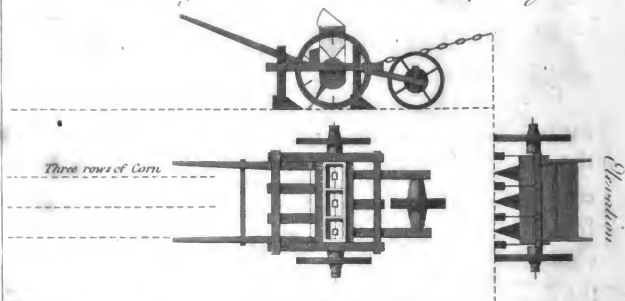
\* This arrangement gives one heap to each four square rods—or to the fortieth part of an acre. If the average quantity of ashes produced from one heap be four bushels, this would be  $4 \times 40$ , or 160 bushels per acre.



Nº4.

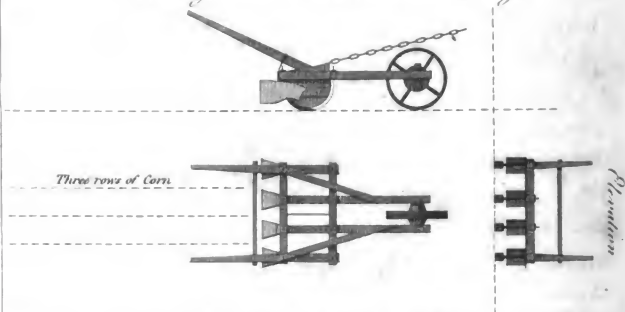
DRILL MACHINE.

*Drawn by one horse. it drills 3 Acres per day.*



Nº5.

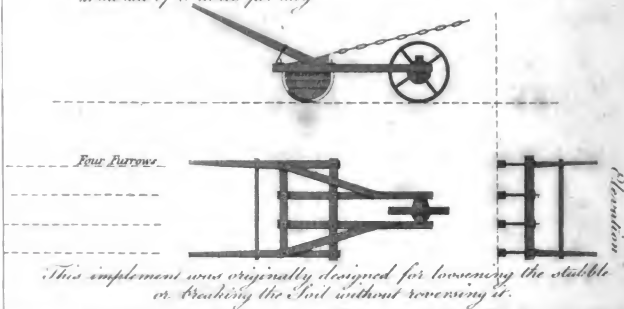
*Machine for placing broad casted Corn in rows.  
Drawn by one horse. it completes 3 Acres per day.*



Nº6.

SMALL PLOUGH, SCARIFIER &c.

*Drawn by one horse. it performs the operations of ploughing &c.  
at the rate of 3 acres per day.*



*This implement was originally designed for loosening the stubble  
or breaking the Soil without reversing it.*

*See direction use at end*

*Publ. & Sold by J. H. Brown*

Scale Four Feet to an Inch.





at four horses, the total power expended is that of 20 horses for one day, in completing and seeding each acre of wheat !

By the method I have hinted at, I have often proved, whilst superintending the operations in the field, that a more perfect pulverization of each acre is obtained, with the power of only four and a half horses for one day. This includes one ploughing with three horses, and all the subsequent operations of scarifying, harrowing, marking, and warping, drilling, and deepening the drain furrows—besides, giving two horse-hoeings between the rows during the growth of the crop.

Before I can convey an accurate idea of this process of preparation, it is necessary I should briefly describe the implements which are used in the several operations above mentioned; and then to deduce, from the daily application of manual and animal labour to each implement, the actual expense of each operation per acre.

1. The *Scotch plough*—or *Plenty's patent* plough. Either of these, with three horses, breaks up the land at the rate of an acre per day.

2. *Small scarifiers* of my own invention. These implements, with the power of one horse to each, perform a variety of operations, at the rate of three acres per day. Hitherto they have

been chiefly used for loosening stubble, pulverizing the soil—and for hoeing between three rows of corn. (See Plate I. Fig. 1.)

3. *Stubble rake.* It is formed of three parallel bars, strongly braced together. On the foremost bar are two wheels at the extremes. The hindermost bar, six feet and two inches long, contains 21 teeth. It is drawn by two horses, and rakes at the rate of six acres per day.\*

4. *A pair of light harrows.* Goes over 10 acres per day.

5. *The marking and warping plough.* This is of a light construction. It is drawn by two horses. It has a common plough-share, but no coulter. The mould boards, which form nearly a right angle over the hind part of the share, expand to four feet and two inches. The hind parts of the mould boards are elevated about four inches above the level of the sock. Upon the beam, is a pivot on which turns the centre of a light wooden rod about  $11\frac{1}{2}$  feet in length. At the extremes of this rod, the markers, which are pieces of wood, or iron, are loosely suspended so

\* A stubble rake, corresponding with this description, has been in use during the last two years : but its form has been altered,—by removing the two wheels from the front bar, and placing a single wheel in front of that bar, in the manner represented in Plate I. fig. 2. By this alteration it is more easily turned at the head-lands.

as to trail at the distances of five feet six inches, from the pivot; these markers by touching the soil (previously reduced to a fine state) leave sufficient marks for the plough to return upon. This simple apparatus performs, at once, three distinct operations. The plough-share forms the warp furrow—the mould-boards move or scrape up the soil on the right and left, and form two half warps: and the markers trace two lines, parallel to the furrow,—at the distance of five and a half feet. These several operations, when properly executed, give the field exactly the appearance of a garden laid out in beds. (See Plate 1. Fig. 3.)

6. *Single harrow.* This, with one horse, is drawn over the middle of each warp, for the purpose of smoothing that part, previously to drilling the crop.

7. *Drill machine.* Of my own invention. It is drawn by one horse—and drills three rows in each side of the warp—so that each warp, five feet and a half wide, has six rows of grain nine inches apart. This drill performs three acres per day. Three small shares, in front of the seed box, open the seed furrows. The two side wheels turn a square iron axle, on which the seed rollers, with cups, are fixed. The seed is thus discharged into three spouts, or conduc-

tors, loosely suspended, which convey it into the seed furrows. These are immediately closed by the four small shares, placed at a small distance behind the conductors, which perfectly cover the seed to any depth that may be required. For this purpose, the seven shares admit of adjustments—and the quantity of seed to be drilled, is regulated in the usual manner by a slider and brush, in each of the three hoppers, or divisions, in the seed box.

To stop the discharge of the seed, the two side wheels are raised off the ground by the handles, and the machine is turned upon the front wheel, at the ends of the warps. With two of these drills, I have drilled several hundred acres in the most perfect manner. (See Plate II. fig. 4.)

8. *Strike plough*. This is a light double mould board plough without a coulter. It is also drawn by one horse, and follows the drill, and completes the warps, by deepening the furrows on each side, for carrying off the rains that descend along the sloping sides of the warps.

These implements are used exactly in the order in which they are placed in the preceding list. The expense of the several operations may be readily computed, by rating each horse at 2s. 6d.—a man as 2s.—and a boy, or driver, at 6d.

per day. These data, combined with the daily effect, or performance, of each implement, are sufficiently accurate for computing the expense per acre—or for comparing one mode of cultivation with another.

The expense of ploughing an acre, with the Scotch or the patent plough, may, according to the above method, be computed thus ;

Three horses at 2s. 6d.	-	-	0	7	6
Ploughman 2s. 6d.—driver 6d.	-	-	0	3	0
			<hr/>		
			£0 10 6		
			<hr/>		

The *small scarifier* goes over three acres per day ; rating the horse at 2s. 6d. the man 2s. and the boy at 6d.—the total is five shillings, or sixty pence, which divided by three, gives 20 pence for scarifying, or hoeing, an acre, once over.

The daily expense of the *stubble rake*, with two horses, a man and a boy, is seven shillings and six pence—which, divided by six acres, gives fifteen pence per acre.

A pair of *light harrows*, with two horses and a driver, will be seven shillings per day—which, divided by eight acres, will give ten pence half-penny per acre for each harrowing.

The *marking and warping plough* is worked at the same expense as the *stubble rake*, viz. seven

shillings and six pence ; but, as the marking or warping plough performs eight acres per day, the expense of its operations is ten pence half-penny per acre.

The daily expence of a *single horse harrow* and a boy, is three shillings ; and as it goes over about six acres per day, or double the space performed by the drill, I rate this sort of harrowing at six pence per acre.

The *drill machine* having one horse, a man and a boy performs at the expense of five shillings per day, which divided by three acres, gives twenty pence for drilling an acre.

The daily expense of the *strike plough* with one horse, a man and a boy, is also five shillings ; but as it performs at the rate of ten acres per day, by making furrows five feet and a half asunder, I rate this operation at six pence per acre.

By altering the positions of the teeth, or tines, of the *small scarifier*, it becomes an excellent *horse-hoe*, and stirs between three rows of corn, at the rate of three acres per day. The expense of hoeing is therefore the same as scarifying, that is twenty pence per acre.

The following examples comprise a summary of the processes of cultivation in the order in which they take place ; and shew the expense of the several operations, and the total expenses of cultivating an acre.

*New System.***EXAMPLE I.** Process and Expense of cultivating an Acre of Wheat upon a Clover ley.

			£.	s.	d.
Ploughing once with three horses	-			12	
Harrowing once	-				10½
Twenty cart-loads of calcined clay,	-	+	1		
Carting from the kiln	-	+		9	
Beating and spreading	-	+		2	
Scarifying three times	-			5	
Marking and warping	-				10½
Harrowing the middle of warps	-	-		6	
Drilling the seed	-	-		1	8
Deepening warp-furrows	-	-			6
					-
	Labour and Manure		2	12	5
Seed wheat two bushels	£ 1				
Rent and Taxes	1	10		2	10
					-
Total			£ 5	2	5

If the items marked + be deducted from £2.12.5, the expense of *pulverising and drilling* this acre amounts to £1.1.5.

Later experience has proved that the ploughing may be dispensed with, and that by two additional scarifyings, making in all five scarifyings, the same degree of pulverisation is obtained, and the expense of cultivation is thereby reduced to £4.13.9. because, the two additional scarifyings would be three shillings and four pence, which being deducted from twelve shillings for the ploughing, leaves a difference of eight shillings and eight pence, to be subtracted from £5.2.5.

**EXAMPLE II. An Acre of Wheat after Wheat.**

	£.	s.	d.
Scarifying the wheat stubble twice		3	4
Raking ditto - - - +		1	3
Collecting and burning ditto (contract allowance) +		4	
Ten loads, or 160 bushels, calcined clay - +	10		
Carting ditto from the kiln - +	4	6	
Beating and spreading ditto - +	1		
Scarifying three times - - -	5		
Marking and warping - - -		10	$\frac{1}{2}$
Harrowing the middle of warps - -		6	
Drilling the seed - - - -	1	8	
Deepening the warp furrows - -		6	
Labour and manure	1	12	$7\frac{1}{2}$
Seed wheat two bushels £ 1   1			
Rent and taxes - - - - 1   10	2	10	
<b>Total</b>	<b>£ 4</b>	<b>2</b>	<b><math>7\frac{1}{2}</math></b>

If the items marked + be deducted from £1.12.7½, the expense of *pulverizing and drilling* this acre amounts to 11s.10½d.

**EXAMPLE III. An Acre of Wheat after Tares, Beans, or Peas.**

	£.	s.	d.
Scarifying twice - - - -		3	4
Raking and burning stubble and spreading +		3	6
Scarifying three times - - - -		5	
Marking and warping - - - -		10	$\frac{1}{2}$
Harrowing the middle of warps - -		6	
Drilling the seed - - - -	1	8	
Deepening warp furrows - - - -		6	
Carting 20 loads of clay ashes from kiln - +	9		
Spreading ditto for contract - - - +	1	6	
<b>Total labour</b>	<b>1</b>	<b>5</b>	<b><math>10\frac{1}{2}</math></b>
20 loads of clay-ashes - - - - £ 1			
Seed wheat 2 bushels - - - - 1			
Rent and taxes - - - - 1   10	3	10	
<b>Total</b>	<b>4</b>	<b>15</b>	<b><math>10\frac{1}{2}</math></b>

If the items marked + be deducted from £1.5.10½, the expense of *pulverizing and drilling* this acre amounts to 11s.10½d.



**EXAMPLE IV. An Acre of Wheat after Potatoes.**

				£. s. d.		
Scarifying twice	-	-	-		3	4
Harrowing once	-	-	-		10	$\frac{1}{2}$
Marking and warping	-	-	-		10	$\frac{1}{2}$
Harrowing middle of warps	-	-	-		6	
Drilling the Seed	-	-	-		1	8
Deepening warp furrows	-	-	-		6	
Labour					7	9
Seed two bushels	-	-	£ 1 1			
Rent and taxes	-	-	1 10		2	10
Total				£	2 17	9

In this example, the expense of *pulverizing and drilling* the seed, was only seven shillings and nine pence ; but it is proper to observe, that the potatoes had been taken up by the spade, which left the land in a favourable condition ; and as that expence belongs to the potatoe crop, it consequently diminished that of the wheat.

**EXAMPLE V. An Acre of Barley or Oats after Wheat.—Old Sussex method.**

				£. s. d.		
Ploughing	-	-	-		17	6
Five harrowings	-	-	-		4	$4\frac{1}{2}$
Harrowing in the seed	-	-	-		1	9
					1	3 $7\frac{1}{2}$
Seed five bushels	-	-	£ 1 1			
Rent and taxes	-	-	1 10		2	10
Total				£	3 13	$7\frac{1}{2}$

The expense of *pulverization and harrowing in the seed*, in this example, is £1..3.. $7\frac{1}{2}$ .

**EXAMPLE VI. An Acre of Barley or Oats after  
Wheat.—New method.**

	£.	s.	d.
Scarifying the wheat stubble twice	-	3	4
Raking ditto	-	1	3
Collecting and burning ditto	-	4	
Spreading stubble ashes	-	5	6
Scarifying three times	-		6
Harrowing in the seed			
Labour and dressing with stubble ashes		14	7
Seed five bushels	£ 1	1	10
Rent and taxes	-	2	10
Total	£ 3	4	7

If the items marked + be deducted from £0..14..7. the expense of *pulverizing and harrowing in the seed*, amounts to £0..8..10.

**EXAMPLE VII. Clover and Ray-grass, among  
Oats or Barley.**

	£.	s.	d.
Rent and taxes	-	1	10
Seeds and sowing	-	1	5
Total	£ 2	15	

In the preceding examples of the culture of wheat, I have separated the operations of *pulverizing and drilling* from the other charges, in order that a comparison might be made between the old and new methods of preparing land, and putting in the seed.

By referring to page 17, it will be seen that

the expense of labour bestowed upon an acre of wheat, according to the old Sussex practice, is - - - £4.3

To which add rent and taxes for the year of fallow (which belong to the preparation), - 1..10



Total expense of preparation and sowing - - - £5.13. per acre.

According to the four preceding examples in the cultivation of wheat, the expenses of preparation and drilling by the new method are thus :

No.	£.	s.	d.	
1. Wheat after clover and ray-grass, the land ploughed once - - -	1	1	5	per acre.
2. Wheat after wheat - - -	11	10	½	ditto
3. Wheat after tares - - -	11	10	½	ditto
4. Wheat after potatoes - - -	7	9		ditto

This comparison shews that there is a clear saving of about five pounds per acre by the new method of preparation and putting in the seed.

By the operations of the scarifiers, without the aid of roller or harrow, the land is reduced to a finer degree of pulverization than can be attained by repeated ploughings and harrowings. This effect is produced with a rapidity, facility, and economy, that the customary method of cultivation does not admit of. The fields destined for wheat are all got in readiness for the seed within a few weeks after harvest : whereas by

the old method, the fourth part of a farm is generally left unproductive for a whole year, before the new crop of wheat is put in the ground. From all these circumstances, added to the great difference between manuring at 20 shillings per acre, instead of £ 7..10—it is not surprising that the difference of expense between the old and this new method should be so very great as will appear in the following comparison.

By the detail in page 17, the expenses of cultivating wheat, according to the old Sussex mode, are £ 16..4. per acre.—The following abstract shews what they are according to the new method, and also the difference, or saving upon each acre of wheat.

	Total expense of new mode of cultivation per acre.			Difference or saving per acre by the new method.		
	£.	s.	d.	£.	s.	d.
Example 1. Wheat after clover -	4	13	9	11	10	3
2. Wheat after wheat -	4	2	7½	12	1	4½
3. Wheat after tares -	4	15	10½	11	8	1½
4. Wheat after potatoes	2	17	9	13	6	3

Although this comparison has been applied solely to the old Sussex practice, which is perhaps fully as expensive as any in the kingdom, yet it seems very probable that its application may extend to many other counties; for I observe by the

reports of the proceedings on the Corn Bill, in the session of 1813-14, that in general the expenses of cultivating wheat are very high.

Mr. James Buxton stated his expenses in the cultivation of an acre to be as follows :

On heavy lands - £ 14.. 2.. 11.

On clay bottom - 12.. 14.. 5.

On light lands - 17.. 10.. 5.

Mr. John Brodie, of East Lothian, stated the expense of preparing his land to receive the seed at five guineas per acre, without including the rent, which is from £ 6. to £ 7.—or the cost of lime. These facts will be sufficient to demonstrate, I hope in a satisfactory manner, the eminent advantages that would flow from the general adoption of so very economical a system of cultivation as that which I have detailed, and which I am now successfully carrying into effect.

The grand source of all the heavy expenses of the old method may be traced to the fallow itself, and to the mode of preparing it. By bringing up immense slags with the plough, as already observed—by reversing the soil—and thus burying the seeds of weeds that had fallen on the surface, a foundation is laid for all the subsequent laborious and expensive operations. To avoid these, we must proceed in a different manner. We have only to break and crumble

the surface soil to any depth that may be required ; to burn and destroy the weeds and the seeds of weeds in the manner I have described ; and then we shall have the land in a fine and clean state of pulverization, and in readiness for receiving the seed, without losing a year's rent and taxes : and all this at a mere trifle of expense, when compared with that which is incurred by a fallow.

#### IV. ON THE ADVANTAGES OF PULVERIZATION.

*Further Illustration of shallow Ploughings—Scarifier compared to four small Ploughs—Its Power computed—Can pulverize with one Horse an Acre of light Soil per day—Example of pulverizing at the expense of Eight Shillings and Fourpence per Acre—Comparison with the old Sussex practice—Scarifier an excellent substitute for the Plough—Hints upon using it—Can stir the Land to the depth of 10 Inches—Loose and porous Condition of the Soil after its Operations—Tull's Opinion of Pulverization—St. Helena Experiment on frequent stirring the Soil—Proves the beneficial Effects of atmospheric Influence.*

IN explaining this new system of cultivation, I have shewn the progressive stages that have led to a very great reduction in the expense of manuring lands, and the means already adopted, as well as those I propose, for the total abolition of fallows. Upon these subjects, therefore, it would be superfluous to add more : but upon pulverization, and the mode of preparing the land for the seed, and upon diminishing the quantity of labour in that preparation, I have yet to offer a few remarks, with some suggestions\* that have resulted from recent experience, which I think will induce me to adopt even a more economical method of pulverizing the soil, than that which has been already described.

The effects of deep and shallow ploughings, have been noticed in the preceding section ; and, I trust, I have demonstrated the advantages of the latter ; and that, by taking only that depth of furrow which can easily be ploughed with *two* horses, and repeating the operation, that the end proposed, (that is the same depth of ploughing,) will be attained with only *one-half* of the animal exertion which would be required to plough the same depth with *four* horses at *one* operation.

The illustration I have given, in page 50, may be carried still further—by supposing the same four horses (which had ploughed, at once, six inches deep, and had overcome the resistance of  $6 \times 6 = 36$ ) applied, separately, to four light ploughs, or other implements—and to plough only  $1\frac{1}{2}$  inch deep at a time, and to go over the same land four times. In this case the sum of all the resistances to be overcome, or the animal force expended, in these repeated ploughings, would be no more than 9 instead of 36; because the square of  $1\frac{1}{2} = 2\frac{1}{4}$ , which multiplied by the four ploughings, gives 9, or only one-fourth of the power expended in ploughing at once six inches deep.

Hence, it appears, that in ploughing six inches deep, with four horses, each horse exerts a force  $= 9$  ; whereas, in taking only  $1\frac{1}{2}$  inch deep, the force he exerts is not more than  $2\frac{1}{4}$ .



Again, supposing that a horse exerts, in drawing a plough, a force of 160 pounds,\* it is evident, if four horses are ploughing six inches deep, the total force exerted will be 640 pounds; or 160 pounds by each: but, if they be required to plough  $1\frac{1}{2}$  inch deep, at a time, then the total force expended by the four horses will be only 160 pounds, or 40 pounds by each horse.

This leads me to the principle on which my small scarifiers are constructed. They have four hoe tines in the hind bar, and I will suppose that there are four harrow tines (instead of three) in the front bar, so that each scarifier may be considered as four small ploughs, with four shares and four coulter. If we suppose one horse attached to this implement, and that the force he exerts is 160 pounds, it is obvious that

\* Emerson affirms, that a man of ordinary strength can act a whole day against a resistance of 30 pounds. The strength of a horse is generally allowed to be equal to that of five or six men. I have therefore assumed 160 pounds as the power of a horse. In the valuable work, entitled "*Nouveau cours complet d'Agriculture*," the power of a horse in drawing a plough is estimated at 150 French pounds.

"Under *Cheval*, it is thus stated, "*Deux chevaux attelés à une charrue, et par conséquent n'allant qu'au petit pas, dans une terre, ni trop aisée ni trop difficile, ont été estimés faire chacun un effort de 150 livres.*"

in scarifying to the depth of  $1\frac{1}{2}$  inch, he will exert those 160 pounds upon the four pairs of tines, or a force of 40 pounds upon each pair.

But, in fact, the force required to draw the scarifier will be considerably less than to draw any form of plough—because the hoe, or share tines, being much thinner and sharper than a plough share and mould board, will, of course, meet with much less resistance in stirring the soil.\*

Having often observed that a small scarifier, with a single horse (taking with its tines a breadth of 27 inches,) easily passes over three acres a day, and that this operation performed three times, upon arable land, produces a good depth of pulverization, particularly when the land is a little softened by rain, I resolved to make an experiment for the purpose of ascertaining the possibility of speedily obtaining all the objects of a fallow, and of four ploughings, of an acre, *with the power of only one horse for one day*, for each acre, instead of *twenty*.

The result has been, that a very good tilth is

\* Experience having shewn that a single horse, without much exertion, easily draws the scarifier, I did not deem it necessary to include, in the computations, the small resistances occasioned by the loose soil laying on the surfaces, after the first, second, and third scarifyings.

absolutely attainable on light lands, after three scarifyings; and at the expense of five shillings per acre: but on a stiffer soil, the power I used, in the autumn 1818, in preparing for wheat after tares, was that of  $1\frac{2}{3}$  horse for one day: so that the expense of this mode of preparation was, *eight shillings and four-pence per acre.*

A field of two acres was allotted for this experiment. One-half was baulk-ploughed, twice scarified, and harrowed once. The other half was entirely prepared by the small scarifier,—which, after five scarifyings, produced as fine a tilth as that which had been baulk-ploughed and scarified. Two bushels of wheat, per acre, were drilled. No difference was perceptible during the growth of the crop, nor at the time of reaping. Throughout the whole field it was even more exuberant than any of my other crops: and this is the more surprising, as the land had received no manure after the three preceding crops. It yielded 460 sheaves of 30 inches in circumference per acre, whilst the average produce of the other fields did not exceed 360. This superiority I ascribe to the very fine pulverisation of the soil.

The result of this experiment clearly proves that the least expensive method of preparing the land for wheat, after tares, beans, peas, or

clover, is simply by using the scarifiers. In the first example, (page 59,) it will be seen, when the land was ploughed, and afterwards harrowed and scarified, the expense amounted to seventeen shillings and ten-pence-halfpenny\* ; but when scarified, *without using the plough*, as in the 2d example, the same depth of tilth, and the same degree of pulverization was obtained in the experiment abovementioned, at an expense of only *eight shillings and four-pence per acre* !

In page 17 and 63, I have shewn, by facts, which cannot be controverted, that those farmers, who adhere to fallows and the old Sussex husbandry, incur the enormous expense of £5. 13s. per acre, for obtaining a less degree of pulverization than I did actually obtain, in the field abovementioned ; and in several other instances, at the very trifling expense of *eight shillings and four-pence per acre*.

Indeed, during the last two years, I have made but a very sparing use of the plough ; and this has enabled me to prepare the lands with much greater expedition than formerly—a matter of no small importance to farmers ; and

* Ploughing once	- - - - -	£ 0 12 0
Harrowing	- - - - -	0 0 10½
Scarifying three times	- - -	0 5 0
		<hr/>
		£ 0 17 10½

so far as I can at present determine, after having recently ascertained so very economical a method of preparing lands for the seed, I think it is highly probable I shall soon be able to dispense entirely with the use of the plough,—excepting for the purpose of making drain furrows, or for paring grass land for burning : particularly, as I have lately experienced that ploughing, or baulk-ploughing, are rather impediments to the scarifiers.

If the slags lay firm on the field, they will then oppose sufficient resistance to the scarifiers, and the surface soil will be broken and pulverized : but, if they lay loosely, which is the case after a recent ploughing, they will be torn and dragged from their places, and the whole field will be covered with long and tough sods, which it would be even more difficult to subdue than the clods of the fallows.

It is very possible that the idea of cultivating a farm *without using a plough*, may be treated as absurd and ridiculous—and may draw upon me the imputation of arrogance and presumption, in daring to call in question the superiority of the plough—an implement celebrated by poets—described as “the most useful instrument that ever was invented”—and which has been in use from the earliest ages. Mr. Locke indeed observes, that, “it is looked upon as an *insolence*

for a man to adhere to his own opinion, against the current stream of antiquity ;” but, with all due deference, I confess, I can perceive neither arrogance, nor presumption, nor insolence, in departing from opinions or customs, (however ancient,) whenever it is proved by facts that it would be advantageous to do so.

This method of cultivation, *without using a plough*, is not entirely my own—excepting, I believe, *in applying it to a whole farm*. It has been partially introduced in England for many years. Mr. Arthur Young, in his directions for wheat, after beans, states, that “it will be more advantageous to trust to the *scarifiers* than the plough :” and, speaking of wheat after tares, he says, “the land *should not be ploughed at all*, but left to consolidate at bottom, to become firm for the roots of the wheat to fix in, and the surface *worked with the scarifiers*, just sufficient to keep it clear of all weeds, and in that state drill the wheat, *without any ploughing*. This I have practised with good success.” *Farmer’s Calendar*, p. 457.

Mr. Young also relates, “a very singular experiment of Mr. Duckett, in preparing a clover lay for wheat.” He had a field in which wheat rarely escaped being greatly root-fallen : *he scarified it repeatedly*, till he had torn up the

clover, and also gained tilth enough for drilling in : then he collected the clover fragments, and carted them into the farm yard to make dung, and drilled the field : the wheat having a firm bottom in an unstirred soil escaped the disease, and yielded an ample produce.”

Again—Mr. Cook says, that “ he cannot consider the plough and harrow of any other use than to attain a proper tilth or pulverization, all which may be obtained by a proper and seasonable use of the cultivator, (or scarifier)” in half the time, and at half the expence.”

M. Bosc, a French writer on agriculture, says, there are some farmers who sow their turnips and buck wheat, vetches and other grains, upon lands prepared by the *Binot*, or even by the harrows. What economy, says he “ does this sort of culture present ! Besides, *when the land is thus constantly covered with plants, the effect of heavy and beating rains is much less felt.*”

I hope these quotations and opinions (which are fully confirmed by my own experience), will

\* Sir John Sinclair, in his Hints on the Netherlands, has given an engraving of the *Binot*. “ In some respects,” says he, “ it resembles a plough with a double, or scuffler, share. By means of this implement the land is *not turned over*, as by the plough, *and the weeds buried.*” Hence, the effects produced by the *Binot* are exactly similar to those of the small scarifiers : with this difference, that these require a much less exertion of an animal strength.

serve to illustrate the vast utility of the scarifier, and will be sufficient to justify the idea I entertain of the *practicability of working a farm without using the plough.*

I lately made an experiment with a one horse scarifier, in order to ascertain the depth to which it would penetrate the land. The soil was stiff, and had been previously baulk-ploughed, and twice scarified : when it had received six additional scarifyings, the tines had gone to their utmost depth, that is, ten inches. Thus the objections started by the neighbouring farmers, to the use of such light implements, were completely refuted ; for, by the power of one horse, a greater depth of pulverization was obtained by eight scarifyings, than by any plough with four horses, and at a much less expense.

To produce a sufficient depth of tilth upon strong stiff land, I will suppose, in some cases, it may be necessary to scarify six times. The expense of these repeated operations would be no more than ten shillings ; since it is only two days work of one scarifier, at five shillings for the day labour of a man, a boy, and a horse : and this perfect pulverization of an acre, is in this manner attained with the labour of only two horses for one day.

Moreover, the land after those six scarifyings, would be loose and porous, and in the finest



condition for allowing the atmospheric air, to introduce itself amongst the minute particles of the soil ; for permitting the rain and dews to spread equally, and for giving to the roots the facility of entering into all the cavities.

Very different from this would be a clodded surface after three or four ploughings : perhaps towards the close of the fallow, or after the last ploughing and rolling and harrowing, some little benefit might be expected ; but, until these finishing operations, the strong cohesion of the clods would absolutely prevent the admission of air and moisture.\* These reflections arose during last autumn, when I observed, even so late as the middle of August, many stiff land fallowed fields covered with immense clods, intermixed with thistles and other weeds. The only advantage derived from this sort of fallowing, appeared to consist in the destruction of the parent weeds, as many of them that had rooted in the clods, would no doubt be destroyed by the heat and drought. At that time, the seeds of weeds which had come up in the interstices,

\* Mr. Tull very justly observed, that “ the fine parts of the earth are impregnated with some of the riches carried in by the dews : but the larger rough parts cannot have that benefit : the dews not penetrating to their centres, they remain poorer.”

exhibited a vigorous crop : but the greater proportion of them was still shut up in the clods, reserved to grow with the wheat, and to share with it all the advantages of the fallow.

Tull was of opinion that land can never be made too fine by tillage ; and that the finer it is made the richer it would become. “ I have had,” says he, “ the experience of a multitude of instances, which confirm it so far, that I am in no doubt, that any soil can be made too fine by tillage.”

That land is greatly ameliorated by pulverization and exposure to the atmosphere, is a fact that is well known : but whether by pulverization alone, it can be made to produce good crops in succession, without manure, is a point I have not yet sufficiently ascertained. I have reason, however to believe, from the result of two small experiments at St. Helena, that the beneficial effects derived from the atmosphere, are much greater than are generally imagined.

In the year 1810, those experiments were established for the purpose of ascertaining the effects of frequently stirring the soil.\* A very unpromising spot was selected : the soil a pale brown friable clay, which in some parts was

\* This experiment is detailed in page 28, Tracts on St. Helena.

bare and barren, in others producing nothing but the coarsest sort of tufted grass. The space for the experiments (measuring two rods in length and one in breadth), was divided into two equal parts. No. 1. was broken up on the 11th of December, by trenching with the spade, to the depth of ten or twelve inches. From that day until the dibbling of the seed, on the 23d of February 1811, it had been at equal intervals, five times stirred or turned. One half of No. 1. was then dibbled with potatoes, and the other with barley; and at the same time, the adjoining square rod was broken up, and dibbled in every respect, in the same manner.

The soil of No. 1., by frequent stirring, had become after ten weeks exposure, of a much darker hue than No. 2., and the potatoes and barley upon the former, were infinitely superior to those of the latter, insomuch, that the tufts of young barley were, on the 22d of April (the last notice I have of the experiment), at least, five or six times more bulky than those upon No. 2.

This result most clearly proves, that the superiority of No. 1., is wholly to be ascribed to the free admission into a well pulverized soil, of all the various nutritive principles with which the atmosphere abounds, for the purposes of

vegetation,\* and the inferiority in the produce of No. 2., affords also a positive demonstration, that when it is practicable, without too much retarding the farming operations, a certain time ought to be allowed for a thorough impregnation of those valuable ingredients before the crops are put in the soil.

But, when circumstances may not admit of sufficient time being allowed, similar advantages may in a great measure be obtained by a perfect pulverization in the first instance ; and by occasionally stirring and opening the soil between the rows during the growth of the crop. By these means, the process of impregnation or absorption of the atmospheric benefits, might keep pace with the growing corn.

\* That we should seek or expect manure from air, will by many of my readers, probably be deemed a very chimerical hope. However fantastical this may appear, it is not less agreeable to reason, than confirmed by experience, that the atmosphere is replete with real material substances, which though too much subtilized and refined to become the direct objects of our senses, afford the true and genuine pabulum of vegetable accretion and augmentation, without which the whole vegetable kingdom would languish and finally decay and expire. From whence these substances originate, and how they are from time to time supplied, is, I conceive, a question of no very difficult solution." (See *Wimpey's Rural Improvements*, p. 225.)

Upon the whole, I think it may be inferred, that pulverization, by implements, produces effects equal, if not superior to those of manure. Indeed the above experiments seem to confirm the opinion of Jethro Tull, that it is even superior in its effects to common manure.

“ I can shew at this instant,” says he, “ one of the experiments I have recommended, which, though it be on less than two perches of ground, that must convince every man who sees it, (and doth not renounce the evidence of his reason and senses), *that pulverization by instruments can vastly exceed the benefit of common manure.*”

This opinion of so celebrated an agriculturist, corresponding with the results of the experiment No. 1., has tended to confirm that which has been already noticed,—“ that I was rather in doubt whether a considerable share of the effect produced, apparently by the calcined materials, ought not to be attributed *to the extreme fineness to which the soil was reduced by implements of small power.*\*

\* M. Bosc, a French writer on agriculture, highly disapproves of a cloddy surface, and considers the plough, as the worst of all implements for stiff lands.

“ Sont-ils laboureurs,” says he, “ ces conducteurs de charruës qui retournent *des mottes de terres d'un pied de large sur deux ou trois de long, et un demi d'épaisseur ? Non. Ce n'est*

To those therefore, who may be disposed to give a trial to the calcined materials as a manure, I would strongly recommend that they obtain before or after they are laid, a perfect pulverization of the soil. Even the calcined materials should be reduced to a fine state ; the finer they are, the more immediate and powerful will be the effect. Of this I had a most convincing proof, in observing the progress of the four experiments mentioned in page 29. Every successive inspection of these experiments, more and more impressed me with a high opinion of the efficacy of burnt clay as a manure : and therefore, I immediately resolved to extend the cultivation of wheat, from four square rods, to upwards of twenty acres.

Upon this scale of cultivation, my success was equal to that of the experiments ; the wheat yielded a return of twelve for one of the seed. This was about thirty-three per cent. better than the usual return in this vicinity ; which upon an average, is only eight from the seed ; or twenty bushels (the average produce) from two

*qu'en multipliant les sillons, les coutres, en choisissant la charruë la plus propre à émietter la terre, qu'on peut dire avoir remplis son objet ; et encore, malgré toutes ces précautions, le labour à la charruë sera toujours le plus mauvais, au moins dans les terres fortes."*

and a half, and sometimes three broadcasted on an acre.

It may well be supposed that this success gave me the fullest confidence. The following year I extended the culture of wheat to even one half of my arable lands. The crops were excellent; and I am perfectly confident, if it were expedient, that by means of fine pulverization, and a proper application of the calcined materials as a manure, I might continue that proportion of land annually in the culture of wheat. The objection however to this mode of cultivation is, that the labour of the farm could not be sufficiently divided. There would be a great pressure immediately after harvest, and a disproportionate demand for the full employment of the teams in the spring months.

For this reason, I give a preference to a four years rotation, because one fourth of the land being in clover, is at rest; and the remaining three fourths in cultivation. This reduces the labour, which is equally divided between the winter and spring preparations.

The circumstances of the four experiments in page 29, and above referred to, deserve particular notice, as they may justly be said to be the origin of my present practice of cultivation.

At the time I was superintending the dressing

of those experiments, the wind blew strong from the north, which caused the powdered dust of the calcined clay, when thrown out of the shovel, to pass beyond the southern boundary of the experiments, upon a space that was left unmanured. This circumstance attracted notice, and it was entered in my farm journal. Soon after the crop came up, I observed a very visible improvement where the dust had fallen. This improvement gradually becoming more visible, reminded me of the effects I had read of gypsum. And I will venture to affirm, it was infinitely greater than could have been produced by an equal quantity of lime. This indeed was admitted by the most intelligent farmers who viewed it. The effect of the dust was decisively marked during the growth of three successive crops ; so that, by this accidental circumstance, it is clearly ascertained that calcined clay, is a more permanent manure than rot dung ; for on the dunged part of this field around the unmanured part of the experiments, the second crop was miserably poor, and the third much worse ; whilst the four experiments dressed with calcined clay, at the rate of ten, twenty, thirty, and forty cart-loads, (or from one hundred and sixty to six hundred and forty bushels) per acre, even surpassed that superiority which they had shewn



during the first and second crops. This progressive improvement, after the soil might have been supposed to have been deteriorated by the two preceding crops, can only be attributed to the lumps of this valuable manure having been reduced to smaller particles, and consequently, more intimately intermixed with the soil.

Although my experiments have been numerous, yet many important points remain to be ascertained. Amongst these is the effect of calcined clay, or other earths, reduced to a perfect dust, and compared with an equal quantity of well pulverized lime. Should the effect of the former be equal to that of the latter, (and I think the circumstances above stated hold out a prospect that it may be superior,) what a valuable discovery would this be ! how infinitely more valuable might landed property be made, if lime can be dispensed with, wherever it is too expensive : and if some of the millions of loads of straw that are annually consigned to the dung-hill,\* were applied to the more valuable purpose of feeding animals. It is not perhaps too much

\* This is a practice unknown in India ; and I believe in China, and in many other countries. Lord Kames very justly observed forty years ago, that “ a provident farmer will never waste his straw by throwing it on a dung hill ; he will provide as many winterers, as to consume all the straw that is to spare from his working cattle. Winterers put

to say, that by these changes, and by the general introduction of calcined earths instead of lime or dung, several millions sterling, might thus be added to the value of landed property. I have tried those materials on corn, potatoes, hops, and grass land, and in every instance they have proved efficacious : I am therefore of opinion, that by combining their use with the drill husbandry, the agriculture of these kingdoms might be carried to a pitch of improvement, far beyond what has ever entered into the minds of financiers.

The burning of clay for manure, appears to have been introduced in England and Scotland about the year 1730 ; *and was found to answer better than either lime or dung* : but the expensive mode of burning it, seems to have rendered it too costly.

Now, as this objection to its general use has been entirely removed, it is hoped that the examples of Mr. Curwen, Mr. Boyd, Sir H. M. Vavasour, Mr. Craig, and many others, may become general throughout the kingdom. I suspect, however, that the slow progress which has hitherto been made, has proceeded from

up in a house save straw ; and the beasts are more regularly fed, and their urine can be wholly preserved : whereas in a farm-yard all is lost but what happens to fall on the dung-hill."

some failures or disappointments, occasioned by defective burning, or by inattention to pulverizing the soil and the burnt clay. It is very evident that if the soil be rough and cloddy, and the burnt clay be laid on in large lumps, there cannot be one tenth (or perhaps even a twentieth part) of the effect produced, that there might be if both the soil and the manure were pulverized, and intimately blended together.\*

\* "The intimate mixture of manure with the soil is the great circumstance of vegetation. In order to that end the soil ought to be highly pulverized, and the manure divided into its smallest parts." Lord Kames' Gentleman Farmer, p. 389.

## V. COMPARISON OF THE OLD AND NEW METHODS OF CULTIVATION.

*New System founded on Practice.—Difficulty of making Converts.—New Schemes ought not to be hastily condemned,—should be carefully examined.—Abstracts of the Old Sussex, and the New Method, shewing the great superiority of the latter, and the Means of augmenting the Value of Landed Property.*

IN describing a system of cultivation, differing in many respects from the common practice, it seemed to me that the best mode would be to give a concise and connected narrative of the whole of my proceedings and practice, from their commencement to the present time : by which it might be seen, that the system I have adopted, is founded wholly upon facts, resulting from my own experience. But, when I considered the difficulty of making converts to new schemes of husbandry,—and adverted to the existing prejudices in favour of old customs, it seemed proper occasionally to refer to those authors, whose practice or opinions, might serve to illustrate or confirm the deductions that arose from the facts that were established.

Accordingly, after having brought the narra-

tive to a conclusion in the last Section, I added a few short notes, which I hope will render the whole more satisfactory ; particularly to those who may have a bias to such prejudices, or who may be disposed to dispute even the evidence of facts, however clearly and positively they may have been ascertained.

The well judging part of the community, will however think differently, they will recollect that a single fact so established, is superior to a thousand arguments ; that no new mode of management (especially one founded on facts) ought to be condemned merely because they are unacquainted with it ; and they will be too generous to pass sentence, without giving it a fair trial.

My earnest desire is, that all and every part of the system may be submitted to the test of experiments. Let comparative trials be made of calcined clay against other manures ; of fallowing against no fallows : and of the plough and harrow against the scarifiers : in short, let the facts I have adduced be opposed by facts ; not by opinions or mere assertions ; before any decision is passed upon a subject—which, I trust I shall clearly demonstrate, is likely to become of the highest importance to the agricultural interests of this country.

A gentleman who manages his own farm, was some time ago conversing on the subject of fallows. I found him strongly addicted to a rough cloddy surface, and to dunging his arable land. He had, however, made an attempt to get rid of fallows ; but, he said he was very glad to return to them—because, he could never keep his lands clean without them.

I assured him I had been more successful, but that my method differed essentially from his. I did not bury, as he did, the seeds of weeds that had fallen during the growth of the preceding crop. The surface soil was not turned over ; it was merely broken, or shattered by implements, so as to loosen the stubble and roots of weeds ; which were afterwards with the seeds that had fallen, and a portion of the soil collected by a rake, and burnt, and the ashes spread. By these means, and introducing the row culture, my lands are now much cleaner, and yield better crops than they formerly did, after all the heavy expenses of lime and fallows.

Those who plough deep, and bury the seeds of weeds by the first ploughing, are not aware, that by this outset of their fallow, they lay the foundation of a great deal of labour and mischief ; and bring upon themselves the absolute necessity of a fallow, as the only means of eradicating

the progeny of those seeds, which they have inadvertently deposited deep in the soil. Now, if the whole of the stubble and its roots, with a small portion of the surface soil, which *must* contain those seeds, be collected and destroyed by fire, it is reasonable to suppose that lands might be as effectually cleared of weeds in this manner, as by a summer fallow: besides, they would have the benefit of a considerable portion of ashes. Perhaps this mode of burning might have a tendency to prevent the disorders of smut and blight: disorders with which my crops have not been in the smallest degree affected.

My method of burning stubble, appears an improvement upon the practice of Mr. William Curtis, of Lynn, in Norfolk, as described in the fourth volume of communications to the Board of Agriculture. His mode appears to have been truly Virgilian, which is described thus:

“ Long practice has the sure improvement found,  
With kindled fires to burn the barren ground,  
When light the stubble, to the flames resign'd,  
Is driv'n along and crackles in the wind.”

Mr. Curtis's stubble was shorn and left about eighteen inches high; and so completely set fire too, as to consume every particle that appeared upon the surface. “This operation,”

says he, "destroyed every weed and seed that grew,—leaving the surface entirely covered with ashes : the consequence was, that his crop of wheat proved extremely advantageous ; its produce being full four quarters per acre. Moreover, *his land treated in this manner was remarkably clean and free from weeds.*

Although enough has been said, to shew the inestimable advantages that would flow from discovering "the errors and imperfections of husbandry," and from correcting them wherever they may be found to exist, yet those advantages will appear in a still stronger point of view by the following comparative abstracts : which exhibit the difference between the expences of one mode of cultivation and another.

I will suppose two farms, the arable land of each consisting of one hundred acres ; that they are both under a four course rotation, consequently divided into four equal portions ; that the one is cultivated according to the old Sussex mode, and the other according to that which I have adopted. Meadow and pasture lands are not included, because they are supposed to be the same on both farms ; and the consideration of them is therefore not necessary for the present inquiry.

For the same reasons the interest on capital,



and all the minutæ of contingencies are excluded from the debit of the farms; nor is credit taken for the straw, which in both cases, is supposed to cover the expenses of harvesting and thrashing the crops. The comparisons are merely confined to the expenses of cultivation, and to the annual value of the crops. The difference between those expenses and the value of the crops, shews the estimated profit, with sufficient accuracy, for exhibiting a general view of the two methods of cultivation.

*Abstract of the Old Sussex Method. No. 1.*

Crops.	Numb. of Acres.	Expense of Cultivation per Acre.	Total expense of Cultivation of 25 Acres.	Annual Value of Crops of 25 Acres.	Difference, or Profit or Loss.
1. Fallow	25	—	—	—	—
2. Wheat	25	£16.	£400	at £10—£250	£150 *
3. Oats	25	3 13 6	91 17 6	at 7— 175	83 2 6
4. Clover & Ray Grass.	25	2 15	68 15	at 5— 125	56 5
	100	£22 8 6	£560 12 6	£550	£10 12 6

Average value of produce £5.5 or £5.10.0. per acre.

According to this very expensive method of cultivation, the tenant is generally a loser by his rotation crops. He could not pay the trifling rent of fifteen shillings per acre, and the poor rates and taxes, if it were not for the profit of his meadow and pasture lands—of the underwoods, hop-plantation, and dairy, and of his young stock; and by taking sixty or eighty

\* Loss upon Wheat.

sheep to pasture during the winter (from Romney Marsh and other places), for thirty-two weeks in the year, at six or seven shillings per head. The result of this view of the expenses and value of the crops, corresponds with what is stated in Doctor Worthington's "*Address to the Practical Farmers of Great Britain*," published in 1810. He tells them, that "under certain unfortunate circumstances, you are losers by your tillage land; and you only maintain your ground by your dairy, sale of young cattle, colts, sheep, and other stock."

*Abstract of the New Method.* No. II.

Crops.	Numb. of Acres.	Expense of Cultivation per Acre.	Total expense of Cultivation of 25 Acres.	Annual Value of Crops of 25 Acres.	Difference or Profit.
1. Tares, Beans, Peas	25	£ 5	£125	at £ 8—£200	£ 75
2. Wheat	25	5	125	at 10 250	125
3. Oats, Barley	25	3 13 6	91 17 6	at 7 175	83 2 6
4. Clover and Ray Grass	25	2 15	68 15	at 5 125	56 5
	100	£16 8 6	£410 12 6	£ 750	£339 7 6

Average value of produce per acre £7.5 or £7..10..0.

Average profit per acre £3.7.10½.

According to this new method, a tenant paying the low rent of fifteen shillings per acre, and taxes, would gain £339..7..6. upon his rotation crops of 100 acres,—besides having the same advantages from his meadows and pasture, underwoods, hop plantations, dairy, and young

stock, and by pasturing the same number of sheep, as he who practices the old Sussex method.

By this comparison it appears, that a farmer who cultivates according to the old method, loses £10..12..6. by his arable lands; whereas, by the new method, he would be a gainer of £339..7..6. upon 100 acres; or £3..7..10½ per acre.

This great difference in the results of the two methods, proceeds almost entirely from the heavy expenses of the fallow and lime: but, as those expenses do not exclusively belong to the wheat crop, being incurred as *a preparation* also, for the succeeding crops of oats and clover, &c.—it is necessary to examine the general effect of those expenses upon the three crops—by taking a view of the charges and produce of each method—allowing one acre only to each division.

*Cultivation of four Acres, by the Old Method.*

No. III.

	Expenses of cultivation.			Value of Produce.		
	£.	s.	d.	£.	s.	d.
Fallow, - - 1 acre	—	—	—	—	—	—
Wheat, - - 1 ditto	16	—	—	10	—	—
Oats and Barley, 1 ditto	3	13	6	7	—	—
Clover, &c. - 1 ditto	2	15	—	5	—	—
	22	8	6	22	—	—

Here the expenses exceed the produce.

Average value of produce per acre £5.5. or £5.10.0.

*New Method.*

## No. IV.

	Expenses of Cultivation.			Value of Produce.		
	£.	s.	d.	£.	s.	d.
Tares, beans, pease, &c. 1 acre	5	-		8		
Wheat, - 1 ditto	5			10		
Oats and barley - 1 ditto	3	13	6	7		
Clover and ray grass 1 ditto	2	15		5		
	16	8	6	30		

By this method there is a profit of £13..11..6. upon four acres, or £3.7.10½. per acre. Average value of produce, £7.5. or £7.10. per acre.

As it is thus clearly proved, that there is no profit by the old method, and a gain of £13..11..6. by the new, upon the rotation crops of four acres, the conclusion that may be drawn from these premises is—that a farmer who adopts the new system, could afford to give his wheat every year, gratuitously to the poor; and yet become a richer man than he who squanders his money and his labour in all the profusion and extravagance of the other.

In the preceding abstracts, the charges of cultivation are rated nearly according to the details of the practical examples, at the conclusion of the third Section. I must however remark,

that in the abstracts of the new method, those charges have been rather over-rated ; consequently, the difference between the charges and the value of the produce, or the profit, is something less than it actually would be.

The value of the crops being supposed the same in both methods, it is of little consequence whether they have been a little over or under-rated, as this would not materially affect the general result.

By the comparison of the abstracts, No. 1 and 2, it is clearly shewn, that the total improvement resulting *from the abolition of fallows — from the application of the cheapest of manure, — and from diminishing the quantity of animal labour*, in the cultivation of one hundred acres, amounts to £350. per annum, or to £3..10. per acre. Consequently, those arable lands, which are now let in the vicinity of my residence at 15 shillings per acre, ought, *under a different management*, to yield a much higher rent, whilst the tenant might be left a larger profit, and at the same time be enabled to sell his produce at a cheaper rate.

To what extent this economical system of cultivation could be carried, it is totally impossible to foresee ; but, for the sake of argument, if

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we suppose the possibility of applying it to ten millions of acres of the arable lands throughout the kingdom, the effect of such a change would be, an accession of thirty-five millions sterling annually, to the interests of agriculture, and of the community at large.

## VI. CONCLUSION.

*Practical Illustration of the New System—Arrangement of the Arable Lands—Mode of preparation for the Crops—The Advantages of burning Wheat Stubble—Clay Ashes a most valuable Manure—Should be well pulverized and incorporated with the Soil—Remarks on the prodigal waste of Straw in Dunghills—On the Import of foreign Grain, and on the great Diminution of our internal Resources—Schemes for extending the Culture of Wheat—Agricultural Improvement a national Object—On the Practicability of extending the Culture of Wheat—Present Culture supplies 8,250,000 Persons with Bread Corn—Plan for supplying 12,600,000 from the present Land in Tillage—or for increasing the home produce of Hemp, Flax, Rape Seed, and other Articles, for Manufacture—requires neither additional Capital, nor additional Expense; whilst it preserves the Interests of Proprietor and Cultivator.—Evils of high Rents, and high Prices—Advantages of fixed and stationary Rents—High Prices the cause of distress to the labouring Poor; low Prices would be an effectual Remedy.—General System of Economy in Cultivation recommended—would be a fertile Source of substantial and permanent Benefit to the United Kingdom.*

I HAVE NOW explained the whole process of my management. It has been shewn, that the principles are established on the solid basis of those facts that were brought to light; in the course of my experiments and practice; and as the result of a four year's rotation, compared with

the old husbandry, even surpasses my own expectations, I am naturally anxious that nothing should be wanting that can facilitate any trials that may be made by others ; for I have no hesitation in repeating, that if the system of cultivation I am now pursuing, were generally extended to those districts where it may be found suitable, (and the implementary part is suitable to all) it would prove of great utility in promoting the interests of agriculture, and many other important national objects.

Hitherto, I have related merely what has been done. I shall now proceed to explain the arrangement, and the plan of cultivation, I am carrying into effect, upon a farm, comprizing  $112\frac{1}{4}$  acres of arable, 8 of hop plantation,  $103\frac{1}{4}$  of meadow and pasture, and  $74\frac{1}{4}$  of underwoods ; in all— $299\frac{1}{4}$  acres.

“ The soil of this farm is in general stiff,—abounding with clay, retentive of surface moisture ; and when dried, by the summer heat, it becomes as hard as a brick, consequently, impervious to the plough, unless with a great power of animal exertion ; and more especially, as the practice is to plough deep.” I have shewn, however, in the 4th Section, that even this stubborn land yields to the irresistible force of persever-



ance: and that by repeating the operations of the scarifier, drawn by a single horse, a most perfect pulverization can be speedily obtained, at a very trifling expence.

Lands of this description are generally supposed to be unfavorable to turnips. Indeed, so far as I have hitherto tried, I have not been successful: and, for this reason, I prefer winter and summer tares, beans, peas, or potatoes, for the green crops: all of these succeed well, and can immediately precede the wheat crops; for which they have been found an excellent preparation.

Either of these crops takes the place of the fallow, and is put in, at a small expence, *without ploughing* the clover lay, after it has been previously dressed with the calcined materials, and well pulverized by the scarifiers.

These crops, therefore, commence the four year's rotation; and are succeeded by wheat, oats, and clover and ray grass, in the same manner as in the old Sussex husbandry.

The fallows being abolished, my rotation becomes thus: 1. Tares, beans, peas, or potatoes. 2. Wheat. 3. Oats or barley. 4. Clover and ray grass.

The arable lands are divided, as nearly as possible, into four equal parts. I take no ac-

count of the hop plantations, meadow, and pasture, or of underwoods, because they are unconnected with the subject of this inquiry,—which is merely to ascertain, *by what means arable land can be made more productive and valuable, and the culture of wheat extended.*

*Division of the Arable Lands—1820.*

1. 28 acres of tares, beans, peas, and potatoes.
2. 28 ditto of wheat.
3. 28 ditto oats or barley.
4. 28 ditto clover and ray grass.

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Total 112 acres.

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The clover and ray grass fields being excluded, there will remain, every year, 84 acres for the autumn and spring preparations. In order therefore to equalise the labour, during the autumn and spring, and to expedite the getting in of the winter crops, 42 acres are allotted for immediate preparation, after the clover and ray grass fields are cleared, and the wheat removed.

The preparation generally commences with carting to the clover lays 280 loads of the clay ashes, for manuring 14 acres for winter

tares.\* The ashes are spread ; and, at convenient opportunities, the scarifiers are employed for obtaining a sufficient depth of tilth.

But this, and every other work of the teams, must give place to the important object of burning the wheat stubble : because, it is upon this operation, that depends the removal of all obstruction to the roots of the succeeding crop, and by which the land is perfectly cleared. If, therefore, the weather prove favourable, after harvest, all the scarifiers are immediately set to work on the 28 acres, for the purpose of loosening the stubble, and having it in readiness for raking and burning ; for, if there should be a wet season, so as to prevent the burning, there would be a considerable expense incurred, by removing the stubble to convenient situations for being burnt in the spring : and in this case, the stubble ashes must be used as a top dressing to the oats or barley, if they cannot be obtained before these crops are put in the ground.

Supposing, then, the season favourable, the wheat stubble burnt, and their ashes spread, soon

\* The remaining 14 acres of clover lays are manured in the same manner, at convenient opportunities ; and are prepared for early drilling of tares, beans, &c. in the spring. No manure is given to the succeeding crop of wheat, unless the tares, &c. appear to have been deficient in produce.

after harvest,—the work of preparing the 28 acres of tare stubble, for wheat, by scarifying four or five times, and the completion of the 14 acres for tares, upon the clover lay, should be proceeded on, without intermission ; so that both these crops may be *drilled* as soon as possible.

Having thus finished the winter drilling, the remaining 14 acres of clover lay can be dressed at leisure with clay ashes, and occasionally scarified ; so as to be ready for the reception of summer tares, or beans, peas, or potatoes, early in the spring. In the same manner, (but without any further dressing than the wheat stubble ashes) the 28 acres that were in wheat, are gradually to be got in readiness for the spring crops of oats and barley and grass seeds.

Particular attention should be paid to having proper drain furrows, in order that the lands intended for the spring crops, may be kept as dry as possible during the winter months. The wheat crops are kept dry by the warp furrows, which are parallel to each other, at the distance of  $5\frac{1}{2}$  feet.

During the course of each rotation of four years, the state of any field can readily be ascertained, by the produce in wheat sheaves, of 30 inches in circumference. Before the reaping commences, a guage is given to each reaper, so

that he may keep nearly to this size ; and before the wheat is removed, the number of shocks is counted, and registered in the farm journal. Thus, the produce in sheaves, per acre, is determined : and as a further proof of the produce in corn,—20 sheaves from each field are set apart, which are weighed before threshing ; and afterwards, the straw and clean grain weighed separately. By these examinations, any farmer might acquire a knowledge of the state of his lands, before he proceeds to cropping them.

For example,—if the wheat produce should be found to fall off, that is, under the average produce in sheaves or corn, per acre,\* an additional dressing of clay ashes, and two or three extra scarifyings, should be given to the land before the succeeding crop of oats or barley is put in ; and if these should not yield well, the clover and ray grass should have a top dressing, of about 10 cart loads of ashes per acre ; which if given during a frost, would prevent injury to

\* My last crop of wheat yielded from 350 to 461 sheaves, of the above circumference, per acre. The most exuberant part of a field (which had long been a sheep-walk, lately broken up, and dressed with clay ashes) yielded, after a crop of pease, from a quarter of an acre, 166 sheaves, or at the rate of 664 per acre. This, at 5 lbs. of corn from a sheaf, would be 55 bushels per acre.

those grasses, by the carting and spreading. If the tares, beans, peas, or potatoes, may have been found deficient in produce, it will then be advisable to give the land a dressing of clay ashes before the wheat is drilled.

But the arrangement and plan of cultivation I have just described, would have been wholly impracticable, without that perfect command of excellent manure, which I have obtained by the burning of clay, soil, and marle.\* It is really surprising, how little attentive land proprietors and the cultivators of the soil are, to the most valuable and important discoveries. It seems hardly credible, amongst an enlightened people, that so little progress should have been made in the use of those materials, after all that has been written on the subject. It is nearly five years since Mr. Craig's letter to Mr. Boyd (dated 28th January 1815) was published ; and still we see, wherever we go, immense tracts of land whitened with lime—in many parts brought from a great distance, to stiff land farms, abounding with un-

\* “ I do not think I am too sanguine, in viewing the general adoption of the system of surface soil and clay burning, as likely to be *the most important discovery for the interests of agriculture*, that has occurred since the introduction of the turnip into Norfolk, by Lord Townsend.”

Letter from J. C. Curwen, Esq. 2 Sept. 1815.

derwoods, which might have been manured at home, and at one-seventh part of the expense.

In the letter referred to, Mr. Craig states, that, "having witnessed the crops of wheat and corn, of every description, as well as flax and potatoes, luxuriant almost beyond credibility, on stiff clay soils, *without the aid of any other manure than clay ashes*, I determined to make the experiment at home."——"So fully convinced," says he, "is Mr. Wallace, of the superior efficacy of clay ashes, that he has repeatedly declared to me, he would not now be at the trouble of carting dung from Kirkcudbright to his farm, though only one mile and a half distant, even if he were to get the dung in a present."——"To you, who have experienced the beneficial result of ashes, obtained by paring and burning the surface, it is needless to have said any thing in favour of ashes obtained from burning subsoil ; or to mention the facility which they afford to the extension of the green crop system, to a breadth not hitherto contemplated."

After what has been already noticed in these pages, of the beneficial effects of clay ashes, it is almost needless to add, that my own practice, upon an extensive scale, has abundantly confirmed the accuracy of Mr. Craig's statements : and so perfectly have I concurred in (nay, antici-

pated) Mr. Wallace's opinion, that I have not, during the last six years, carted a single load of dung to my arable lands, excepting to a few acres of potatoes. The whole has been appropriated to the hop plantations, where *the weeds it generates* can easily be destroyed ; and what was to spare, has been laid on the meadows. As to lime, I have long considered it the bane of many farmers, who bring it from a great distance,—the great draw-back on their profits,—and one of the primary causes of the high price of provisions.

In confirmation of this opinion, I beg to refer to the statement of the expenses of cultivation, in page 17 ; which I think must convince any one, “ who doth not renounce the evidence of his reason and senses,” that liming and fallowing are infinitely more the sources of agricultural distress, than that “overwhelming taxation” of which we hear daily complaints. This is an unavoidable evil, for which there is, unfortunately, no remedy : but for liming and fallowing, I hope I have clearly proved, that the remedy is absolutely within our reach ; and that in order to attain it, we have only to get a knowledge of the errors and imperfections of husbandry, throughout the kingdom ; to correct them wherever they exist ; to abolish all expen-



sive modes of cultivation, and to introduce a general system of economy in every operation of farming.

This knowledge might be easily acquired ; for wherever we find the rent of lands low, and the expense of cultivation high, some error or mismanagement may be suspected. There, let minute inquiry be made into the operations of the farmer ; let him be traced from the commencement to the close of his rotation, whatever it may be ; and let every item of his expense be detailed in the order in which it is incurred. Let also the soil and situation, and the resources of his farm, as to lime, clay, marle, peat, and fuel, be noted and compared with other farms, under similar circumstances, where rent is high and the expenses moderate, and we shall then discover what may be the proper remedies to apply. If such investigations were attended to by the land proprietors throughout the kingdom, and if they would take the lead in introducing the *most economical and most profitable systems*, and be at some pains to instruct and encourage their tenants to adopt them, the happiest effects might reasonably be anticipated. Many discoveries might thus be made, tending to the advancement and perfection of agriculture : and in the course of a short time (if those discoveries were

promulgated), the whole of the lands of the kingdom might be raised to the utmost value of which they were capable.

But, hitherto the greatest obstacle to improvements in cultivation, has been the insufficiency, or want of manure. That this want can now be most abundantly supplied in almost every part of the kingdom, at a far cheaper rate than lime or dung, has been partially known for some years past. To what has already been written on the subject of "clay ashes," as a manure, and experienced by others,\* I have added the result of my own practice ; which leaves no doubt in my own mind, that the greatest advantages would result from a general introduction of that inestimable manure. I say inestimable, because I

\* "From the beneficial, nay, I may say, *wonderful effects I have for years observed of ashes* upon my own estate, and now fully confirmed by Mr. Craig's and Mr. Wallace's practice, I trust the Galloway farmer will no longer confine his green crop from the want of manure, to a few acres." Letter from Edward Boyd, Esq. of Merton Hall, 1st February, 1815.

"I have manufactured for use this season, two thousand carts of ashes (single), and have raised from them fifty acres of turnips (Swedish), with *sixty carts of ashes*, fully equal to what had *a hundred of good dung*. Twenty-one acres with thirty carts very good." Letter from J. C. Curwen, Esq. Workington Hall, 2d September, 1815.

believe it to be *the cheapest and the most convenient*, that a farmer can make use of.

But to do it justice, to render it efficacious, and to prevent disappointments, it is absolutely necessary that the pulverization of the soil, as well as the manure, should be particularly attended to. It is to a want of these precautions that may be ascribed some failures, of which I have heard ; for in no one instance has it failed with myself. I have had many proofs of its superior effect to that of dung, when the trials have been made with equal quantities of each ; nay, by the four experiments, noticed in page 29, it was most clearly manifested to many persons who inspected them, that even ten cart loads of those ashes per acre, greatly surpassed in effect the forty loads of dung per acre, with which the rest of the field had been manured.

The least expensive method of producing the requisite degree of pulverization, is *to spread the clay ashes over the land previously to its being scarified*. Should there be any large lumps, these may be broken with a mallet, or spade, or hoe. By this means, and three, or four, or five scarifyings, the pulverization will be completed ; and the soil and manure will be intimately blended together, and in the finest condition for receiving the seed.

Although I have thus advocated the cause of clay ashes, I beg it may be understood, that I am not insensible to the value of lime or dung; I know the beneficial effects of both; but my objection to their use on arable land, arises chiefly from the great expense;—besides, I am decidedly of opinion (as I have before stated), that the lavish expenditure of straw in dung-hills, is a practice that requires correction. British farmers would do well to take example from those, they are apt to imagine as less enlightened nations. Amongst the Indians and Chinese, straw is considered too valuable to be thus squandered. They apply it almost exclusively to the feeding of animals. In the year 1818, when the crops of hay had failed, I adopted this practice, and found great advantage in doing so. The farm yards were littered with coarse grass, after having been previously bedded with peat or soil. It was an accidental lesson, of which I shall not fail to profit: most farmers who may adopt this plan of economy, would find their means of feeding stock greatly augmented, and that instead of having occasion to buy hay, they might have some to sell: or, by *reducing their meadows and pastures, they might enlarge their scale of cultivation.*

Enough has I presume been now stated, for the purpose of explaining the whole of my

process and management, and of shewing the success with which it has been attended. The principal object I have had in view in bringing it forward, has been to draw the attention of landlords to the little interest that many of them take in the culture of their estates ; to invite them to attend more particularly to this object ; and to endeavour to convince them, that in improving their property, they would labour, not only for themselves, by augmenting their revenue, but they would most essentially contribute to the comfort of all classes of the community, and to the prosperity of their country, by rendering provisions plentiful and cheap.

The many great national advantages which would soon result from land proprietors taking the lead in improvements, did not escape the penetrating eye of Buonaparte. He directed the Minister of the Interior to express his wish to be informed of the progress of agriculture ; and on this occasion he declared, that, *it is chiefly by the residence of proprietors upon their estates, by the examples they may give in cultivation, and by their care to ameliorate the condition of themselves and children, that any progress can be made in rural economy.*

One of the favourite maxims of Sully, the memorable minister of France, was—that tillage

and pasturage were the two breasts of the state. He regarded agriculture as the base of its power, the support of its grandeur, and the source of public good. M. Mirabeau entertained similar opinions: he declared, that agriculture is the first of arts—the most useful, and most necessary to man, *but the least attended to, for no means are taken to bring it to perfection.*

It needed not, however, this retrospect to remind us of the importance of agriculture. A noble Earl, upon moving the second reading of the Corn Bill, in March, 1815, most justly observed, that “agriculture was the most important of all considerations. Although small states, said his Lordship, could not look to it as a means of wealth, it was very different with those which had a population of 10 or 20 millions to supply: such countries could not be dependent upon others for an article of the first necessity, without the greatest possible risk.”

Unfortunately, this dependence and risk are rapidly increasing. In the year 1816, as I have already observed, the value of the import of foreign and colonial corn, grain, meal, and flour, was £ 942,497..19..7. ; in 1817, £ 6,403,893..10..6. ; and in 1818, £ 10,908,140..0..2..! Surely, then, it becomes the wisdom of this great nation to look into the causes of this alarming

increase, and to use every possible means to check the growing evil : for it seems to be admitted by all writers on political economy, that *a nation which depends not on itself, at least, for the necessities of life, all powerful as she may be, has a power but poorly founded.*"

In former times we grew more than sufficient for our population. From 1700 to 1750, our exports exceeded the imports 29 millions quarters of grain of different sorts : from 1751 to 1799, the imports exceeded the exports 13 millions.\*

Sir John Sinclair, in his "Hints regarding the Corn Laws," states, that within "the short period of twenty years (that is, between 1796 and 1816) we have exported little short of sixty millions sterling for grain, *exhausting, for articles that might have been raised at home, our metallic currency ; stimulating the agriculture of hostile nations, and swelling their financial resources for our destruction.*"

This great diminution in our internal resources appears to have proceeded, in a great measure, from the increased expenses of cultivation, which

\* In the fourth volume of the Farmer's Magazine, page 421, these quantities are stated to have been 29,256,573, the excess of *exports* during the first 50 years ; and 13,674,979, the excess of *imports* during the last period.

render wheat, in many instances, a very unprofitable crop—from additional taxes—and from that refinement in rotation crops, which admits of only a small proportion of our arable lands been appropriated to wheat.

In regard to the expenses of cultivation, I have given a practical demonstration of the means by which they may be very greatly reduced ; and by which the produce of the lands already in cultivation might be greatly increased. Taxation does not come under the control of the farmer : but, in respect to rotations, which are founded upon the facility or difficulty of procuring manure, I hope I have shewn that there is now no longer a necessity for prolonging them to a period of five or six years, or more, before the return of a field to a wheat crop.\* I have

\* Mr. Young has remarked, in his *Calendar of Husbandry*, that before the reign of His Majesty George the Third, there was not one writer who had any tolerable ideas upon the importance of rotation crops. Subsequently, however, it would appear, that those ideas became rather too refined, when, by long and tedious rotations, a farmer must wait six or seven years, before certain fields *are supposed to be* in a condition to receive their second crop of wheat. Thus he reserves only a sixth or seventh part of his arable lands for that most useful grain, instead of a fourth or a third.

“ As to the observation of any particular course,” (Mr. Lawrence justly observes), “ nothing can be more inimical



not the least doubt, that by the plan I am now pursuing, I might have, *in profitable culture*, one-half of my arable lands every year in wheat : the only rotation I need observe, is that of wheat and green crops alternately.

But the objection to this method has been already noticed : the labour of the teams would not be sufficiently divided. However, if by my future trials I may discover that spring wheat can be successfully cultivated, I might then allot the barley and oats division, of 28 acres, to that grain, which would give one-half, or 56 acres, in wheat every year, without any additional expense, and without deranging the

to the true interests of the proprietor of the soil. That man," says he, " observes the best course, who drains, pulverizes, and cleans his land, keeping it in constant heart : he may thus bid defiance to all regularity of cropping, and take from his field the species of crop he may deem most advantageous. *Hoed wheat repeated*, would be a great and infallible means of replenishing our markets ; or by alternate crops of wheat and beans, a course well known to be successful."

An anonymous writer " on the culture of wheat," expects the period to arrive when wheat shall take place of oats and barley throughout the kingdom. By this," says he, " the condition of the working classes would be improved in a very great degree." Of this there can be no doubt ; and to effect it is, in my opinion, not impossible.

equalization of labour for the teams in the autumn and spring. According to this mode of management the rotation would be thus :

Division.	Acres.		Value of Crops.	Expense of Cultivation.	Difference in Profit.
			£.	£.	£.
1	28	Tares, beans, peas, &c.	224	140	84
2	28	Winter wheat - -	280	140	140
3	28	Spring wheat - -	252	140	112
4	28	Clover and ray grass	140	77	63
	112		896	497	399

Average value of produce £8. per acre.

But in this case I should have occasion to purchase oats or barley ; so that upon the whole, it might not be much more profitable than the rotation I have chosen—viz. 1. Tares—2. Wheat—3. Oats or barley—4. Clover and ray grass. At the same time I must observe, that the above mode of cropping would be an effectual means of insuring a surplus produce of wheat for the purpose of exportation ; and by which England might be restored to, what she was for many years, a corn exporting country.

There is, however, another mode by which the proportion of wheat upon this, or any other farm, may be augmented, without interfering with the arrangement of the succeeding crops, or with the equalization of the team labour for the autumn and spring months.

This may be done by postponing the tare crop on the clover lay until the spring, and by drilling 14 acres of winter wheat upon the third division (as in No. VII.) By this alteration there would be 42 acres of the 112 in wheat every year : the other half of the third division being in oats, would give a sufficiency for the farm horses. Moreover, this alteration would be rather more profitable than any of the others, as will appear by the following comparison.

No. VI. *Comparison of the two Modes.*

Rotation at Knowle Farm.

Division.	Acres.		Value of Crops.		Expense of Cultivation.		Difference in Profit.	
			£.	s.	£.	s.	£.	s.
1	28	Tares, beans, &c. at £8.	224		140		84	
2	28	Wheat - - - 10	280		140		140	
3	28	Oats and barley - 7	196		102	8	93	12
4	28	Clover and ray grass 5	140		77		63	
	112		840		459	8	380	12

Average value of produce per acre £7.5 or £7.10.

No. VII. *Wheat Culture extended to 42 Acres in 112.*

1	28	Tares, beans, &c. at £8.	224		140		84	
2	28	Wheat - - - 10	280		140		140	
3	14	Wheat - - - 10	140		70		70	
0	14	Oats - - - 7	98		51	9	46	11
4	28	Clover and ray grass 5	140		77		63	
	112		882		478	9	403	11
Difference or additional profit by this mode							22	19

Average value of produce per acre £7.88, or £7..17.

The expenses of cultivation are computed at the same rates as in the comparisons in the preceding Section ; that is, £5. per acre for tares, &c. and wheat,—£3.13 .6. for oats,—and £2.15. for clover and ray grass.

I have noticed these modes of extending the culture of wheat, as additional proofs of the vast importance of clay ashes as a manure. Indeed, in every point of view, they are unquestionably a most valuable acquisition to our agricultural systems. The farmer who uses them with the precautions I have mentioned, of *fine pulverization*, and burning the stubble and weeds, &c. may bid defiance to all regularity of cropping, and take from his fields the species of crop he may deem most advantageous.

From a field of nine acres, I have already had two successive crops of wheat. The second was much better than the first ; and I have this year cropped it a third time. The stubble was raked out and burnt, and the ashes spread ; and the whole field has had a dressing of 10 cart loads of clay ashes per acre. One half is drilled, the other broad-casted ; and afterwards put in rows with the new implement, Fig. 5, Plate II.

This field is intended for experiments, with a view of ascertaining the possibility of cropping the same fields with wheat, for at least

two or three years. If that practice should be found successful, it would lead to the greatest improvements in our agricultural systems,—by rendering them more profitable: whilst a smaller extent of arable land would suffice, for yielding an abundant supply of that most necessary article of food for our population. Of the ultimate success of the experiment I have now in process, I do not entertain the smallest doubt; for as Jethro Tull raised on the same land 13 successive crops of wheat, without a particle of manure, it is reasonable to expect that my experiment is even more likely to succeed; since it is my intention to refresh the land with occasional dressings of clay ashes, proportioned to the deterioration I may observe in the preceding crop.

The second crop of wheat, above-mentioned, when in full ear last autumn, was viewed by many persons, as something new and extraordinary. After General Durham, of Largo, in Fifeshire, had rode over it, and minutely inspected it, he exclaimed—“If you can do this, and have wheat after wheat, you will out-do all the farmers, both in the North as well as the South.”

Indeed, if this important point shall be satisfactorily established by one or two years's longer experience, the natural consequence will be,

that farmers, by being thus relieved from the shackles of rotations, would be enabled to extend the culture of wheat very far beyond what it has ever yet been ; and this country might soon be made to raise, not merely an abundant supply for its population, but might become a great emporium of corn,—at least to any extent for which there might be a demand : for if it can be proved that we can take, in profitable culture, wheat after wheat, this article, which is of the greatest importance to mankind, might then be in the greatest plenty, and consequently cheap. The advantages to all classes would be great :—the rich would then bear more easily the burthen of taxation : the condition of the labouring population would be more happy and comfortable : and by means of this cheapness, there would be a very considerable reduction in the poor rates.

If I am not mistaken in these inferences, the national benefits that would result from cheapness of bread corn, would be immense : and therefore we ought to strive to keep down the price of wheat—to enlarge the scale of its cultivation, and to retain this branch of the corn trade wholly in our own hands. This is much more essential than any other, because the price of wheat affects all classes : whereas, comparatively, that of oats and barley concerns only a few.

It has always appeared to me a great defect in our agricultural systems, that so small a proportion of the arable lands has been appropriated to the food of man, and so much to that of animals. If we look into our boasted rotations, we shall find, that in many of them a fifth or sixth, nay, even a seventh part of a farm is all that is allotted to wheat, whilst the rest is cultivated chiefly for the use of animals.

That this is not the practice in those countries where the food of man is plenty and cheap, we have only to look to China. There—"the whole surface of the empire is, with trifling exceptions, dedicated to *the production of food for man alone*. Few parks and pleasure grounds are seen, except those belonging to the emperor. Little land is taken up with roads, the chief communication being by water. There are no commons or lands suffered to lay waste, through neglect or caprice, or for the sport of great proprietors. *No arable land lies fallow*. And whatever defects there are in the soil, it is supplied by mixture with other earths, by manure, by watering, and by careful and useful industry of every kind."

The consequence of all this attention to agriculture is—that the population, upon an average, throughout that vast empire, amounts to three

hundred inhabitants to every square mile, which is nearly three times the population of this country: "and yet these people are maintained in plenty, without any assistance from other nations." \*

But the system I am now aiming at (for much remains yet to be done) is calculated to remedy the defect I allude to, by having a much greater proportion in wheat, *without reducing the quantity of food for animals*. This I conceive to be perfectly practicable, by withholding a great portion of the wheat straw from the dunghill: and by using it for the far more valuable purpose of fodder.

I have now only to add, that there is a facility in my mode of cultivation, peculiarly suited to a gentleman farmer. By taking care to have, at all times, a sufficiency of clay ashes, for the purposes he may require, he has no occasion to be anxious about the increase of his dunghill. He need not, therefore, trouble himself (unless he chooses) with the feeding of any other stock than his working cattle and horses. He may sell a portion of his hay or straw, without any detriment to his farm; since the exhaustion of the soil

\* Sir George Staunton's Account of Lord Macartney's Embassy to China,



can be restored by an extra dressing of the clay ashes, whenever it appears to require it. My 112 acres of arable land, and 8 acres of hop plantation, together with the work for a brick kiln, and the carriage of wood from the under-woods, &c. are now managed by four horses and four oxen. If it were not that horses are necessary for the drilling and hoeing of crops, and more particularly for the hop plantations, I should have endeavoured, with a view of completing this system of rural economy, to have worked my farm entirely with oxen.

A minute diary is kept, of every transaction ; from which can be ascertained the expenses of cultivating each field, as well as the produce. Besides this, the crops are forecasted\* for five or six years to come. This forecasting, which is given in detail to the bailiff, enables him to foresee, and to prepare for, the crops of the several fields, so as to get them in at a proper season. Thus, all confusion and hurry are avoided : the work proceeds in an easy and regular manner : and I have no doubt, that under this sort of management, entrusted to careful and honest bailiffs, a

\* But when cold weather and continued rain,  
The lab'ring husband in his house restrain,  
Let him forecast his work with timely care,  
Which else is huddled, when the skies are fair.

Virgil. Georgic I.

considerable extent of landed property might be cultivated, in a manner almost as satisfactorily to the proprietor, as if he himself were to reside on the spot, and superintend the operations. Occasional inspection would however be proper, in order to examine the state of the fields, and to compare the labour bestowed upon them, with that detailed in the diary and the farm accounts. After a little experience, and a careful examination of the items of expense, it would be easy to ascertain, with tolerable accuracy, the quantity of labour that each field may require. There is, in my opinion, no more difficulty in *foreseeing* and *estimating* the labour and expenses of cultivation, than there is in estimating those of a building, or of any other work, before it is erected.

But, farming is too often conducted in a loose and unmethodical manner. Few cultivators can give a satisfactory account of their expenses, nor of the proceeds from their lands: they take not the trouble to look into them: they remain satisfied, that after paying the customary rent of the parish or district, and after pursuing the customary course of husbandry, there must be some profit, because their predecessors had a profit. This is enough for them to know: they care not at what expense they cultivate their lands. It is

in fact no business of theirs,—consequently, they are totally indifferent about any changes or new plans ; since experience has taught them to know, that the old system will answer their purpose. In that too there is no risk ; whereas, in any new system, it would be difficult to persuade them, by argument, that there is a certainty of gain.

I am far, however, from thinking it would be necessary to reform all the ancient usages. In many cases it may be expedient to preserve them ; as no doubt many have been ascertained to be the most advantageous. There are, however, certain routines of practice, for which no substantial reasons can be given ; and which, if proved to be bad, ought undoubtedly to be abolished. I know no other method so likely to effect a change, as by the example of the proprietors. It is to them that we must look for the extension of improvements. It is only by the facilities and the indulgences they may afford,—by their reasoning with their tenants,—and above all, by successful examples placed before their eyes, that they will be prevailed upon gradually to abandon their prejudices : from which, however, they will be ready enough to depart, whenever they shall be convinced and assured of a greater profit.

But this profit will entirely depend on the liberality and indulgence of the proprietor, and upon the manner of adjusting the rent after the introduction of any new plan, by which the tenant may have derived a manifest advantage. It seems to me, that it would ultimately be for the interest of the proprietor, to take no share of that advantage for the first, or even the second year, —to give all to the tenant. This would operate as a powerful stimulus to his exertions: the new and improved system would be perfectly established, and all classes of the community would be benefitted by the greater abundance of corn, and by the farmers being enabled to sell it at a cheaper rate.

After the expiration of the limited time, whatever it may be, the proprietor and tenant might enter into an arrangement for a share of the increased profits being added to the former rent. Here too, there should be great indulgence shewn to the tenant, otherwise the prices of corn would rise; consequently, the greatest possible reductions in the expenses of the farmer would be nugatory, if he were borne down by a heavy rent; since his reduced expenses, added to a *high* rent, might be the same as his former greater expenses added to his *low* rent. Under such

circumstances, the proprietor alone would be the gainer ; and very little public benefit would be felt.

But, as all agricultural improvements should have in view the national interests, and the comfort and welfare of all classes of the community, these great and important objects would undoubtedly be best promoted, if the land proprietors were to forego all claim to any share in the advantages that might arise from improvements, and remain satisfied with their present rents, which have been raised to a higher pitch than formerly, by the enormous rise in the prices.

During the period between 1793 and 1814, wheat rose from 48 shillings to 101 shillings per quarter ; and other articles nearly in the same proportion. What an immense additional value was thus transferred to the hands of the proprietors and cultivators, *at the expense of every other class of the community !* It is very obvious, from the preceding data, that the same quantity of land that had yielded only 24 millions sterling, for wheat, in the year 1793, must have yielded more than 50 millions in the year 1814 !\* This general view of the effect of raising the prices, will be sufficient for the purpose of shewing that the proprietors of land ought to be perfectly

\* Explained in page 144.

satisfied with the present scale of rent ; and that they might well afford to allow the nation and the community the full benefit of any improvements that may hereafter take place in the affairs of agriculture.

In respect to the rent of land being the effect, or the cause, of high prices, two opposite opinions are entertained. Doctor Adam Smith maintained that *“rent forms one of the component parts of the price of raw produce ; and that the proportion which falls to the landlord would be increased by a diminished cost of production :”* on the contrary, Mr. Ricardo positively affirms, that *“rent does not, and cannot enter in the least degree, as a component part of the price of raw produce.”* Both these celebrated writers may be correct. The difference between them seems to proceed from the different views they have taken of the same subject. Adam Smith speaks of rent in the popular sense in which the term is usually applied ; whilst Mr. Ricardo is of opinion—that rent is often confounded with the interest and profit of capital ; and that it is of the utmost importance to the clearly understanding of the principles he is about to explain, that rent should be considered separately and distinctly from profit and capital.

This question is of little consequence to the

farmer. In his calculations he usually considers, that rent is as much a part of his expenses of cultivation, as his labour, manure, seed, &c. In the statements I have had occasion to make, I have so considered it: nor do I see in what other way it could have been applied, by which the profit and loss account could have been made out, so as to have given a clear and accurate result.

Mr. Middleton, in his view of the agriculture of Middlesex, has made an estimate of the quantity of arable land in South Britain, deduced from the number of inhabitants—which, at the time he wrote, he rated at eight millions. He supposes that each individual who eats wheaten bread, consumes annually one quarter, or eight Winchester bushels,—which include puddings, pies, confectionary, and every other application of wheat in the article of food. This quantity of wheat is equivalent to the average net produce of half an acre; that is, after deducting seed, loss by vermin, accidents, &c. from the gross produce, the remaining net quantity is sixteen bushels per acre.

After ascertaining; in this manner, that the quantity of arable land in South Britain is about 14 millions of acres, he adopts the hypothesis—that every 10 millions of acres are cropped in the following proportion:—

## No. VIII.

	Acres.	Value of Crops.*	
Wheat - -	2,750,000	£27,500,000	at £10
Oats and beans -	2,500,000	18,750,000	7 10
Barley and rye -	750,000	5,250,000	7
Roots - -	1,000,000	8,000,000	8
Clover - -	1,000,000	5,000,000	5
Fallow - -	2,000,000	- - -	
Totals	10,000,000	£64,500,000	

Average value of produce, per acre, £6.45.

By which it appears, that the corn crops, including beans, are in the proportion of 6 to 10; the green crops, in that of 2 to 10; and the fallow, of 2 to 10.

He then applies the foregoing postulatam, and shews, that 14 millions of acres of arable land, in England and Wales, are annually cropped with the following quantities of each kind of grain, &c. thus:—

## No. IX.

	Acres.	Value of Crops.*	
Wheat -	3,850,000	£38,500,000	at £10
Barley and rye -	1,050,000	7,350,000	7
Oats and beans -	3,500,000	24,500,000	7 10
Clover, rye grass, &c. 1 year's ley }	1,400,000	7,000,000	5
Turnips & other roots	1,400,000	11,200,000	8
	11,200,000		
Fallow -	2,800,000	- - -	
Total.	14,000,000	£68,550,000	

Average value of produce, per acre, £6.35.

\* The value of crops is estimated at the same rates as in the other abstracts. Oats and beans being here in the same class, are rated at the medium value of both, in the former statements.



By the nine preceding abstracts, sufficient data have been established for a comparison of the relative *value* of the produce, according to the several courses, or rotations, therein specified; from which may be deduced the most advantageous system of cultivation, in so much as respects the *quantity* of productions from the same extent of land; which (adhering to Mr. Middleton's computations) I shall take at 10 millions of acres.

But, as Mr. Middleton has not furnished us with the expenses of cultivation, which are essentially necessary for establishing the profit or loss upon a system, I shall, in the first place, give an abstract of the expenses of cultivation, quantity or value of produce, profit or loss, of 10 millions acres of arable land, managed according to the old Sussex practice; and a similar abstract of the system I am now pursuing; with a statement of the results of those I have suggested for enlarging the scale of wheat culture throughout the United Kingdom. I shall then conclude, by comparing the effects of these several rotations, with that which Mr. Middleton has *supposed* to be the probable course of cropping, throughout England and Wales.

*Abstract of the Old Sussex Method, applied  
to 10 Millions of Acres.*

No. X.

	Acres.	Expenses of Cultivation.	Value of Crops.	Profit, or Loss.
		£.	£.	£.
Fallow	2,500,000			
Wheat	2,500,000	40,000,000	25,000,000	15,000,000—Loss.
Oats	2,500,000	9,187,500	17,500,000	8,312,500—Profit.
Clover & } ray grass }	2,500,000	6,875,000	12,500,000	5,625,000—Profit.
Totals	10,000,000	56,062,500	55,000,000	1,062,500—Loss.

The expenses of cultivation, and the value of the crops, are rated the same as in Abstract, No. I, page 93. The results are,—that by this method, there would be a loss of fifteen millions annually upon the wheat; and a profit of £13,937,500. upon the oats and clover, &c.: so that the loss upon the 10 millions of acres of arable land, amounts to £1,062,500. per annum.

*Abstract of the New Method, as practised at  
Knowle Farm, applied to 10 Millions of Acres.*

No. XI.

	Acres.	Expenses of Cultivation.	Value of Crops.	Profit.
		£.	£.	£.
Tares, beans, &c.	2,500,000	12,500,000	20,000,000	7,500,000
Wheat -	2,500,000	12,500,000	25,000,000	12,500,000
Oats and barley	2,500,000	9,187,500	17,500,000	8,312,500
Clover & ray grass	2,500,000	6,875,000	12,500,000	5,625,000
Totals	10,000,000	41,062,500	75,000,000	33,937,500

The expenses of cultivation, and the value of crops, are rated the same as in Abstract, No. II, page 94. The results of this new method are,—that there is a gain of £7,500,000. by substituting tares, beans, &c. instead of a fallow—a gain of £12,500,000. upon the wheat, instead of a loss of £15,000,000. as by the former method. The profits on the oats and clover, &c. are the same in both. Now, as the total profit by the new method is £33,937,500. and the loss by the old £1,062,500. it is obvious, that the advantages that would accrue from the introduction of the former, upon an extent of ten million acres, supposing them to admit of the same degree of improvement, would amount to the enormous sum of thirty-five millions sterling per annum. This result corresponds exactly with the deduction drawn from a comparison of the old and new methods, at the close of the 5th Section.

But even this new method of cultivation, however advantageous it may appear, in regard to profit, and the accession of 20 millions value to the resources of the country, (at an expense of 15 millions a year *less*\* than by the old method)

\* It is deserving particular notice, that the expenses of *cropping* 2,500,000 acres of the lands in fallow, would be fifteen millions sterling per annum *less*, by the new method, than by the old,—proceeding from the enormous charges for labour, lime, &c. &c. as before mentioned.

yet it is equally defective in one very essential point as the other,—by yielding too small a proportion of wheat—not more than sufficient for the supply of 5 millions of persons.

To enlarge the scale of wheat culture, has long since appeared to me an object of the highest importance, and one deserving the most serious consideration ; for if, by any means, we can attain it, *without detriment to landlord or tenant*, the beneficial effects to this country, circumstanced as it now is, would be incalculable. I have already stated the progress I have made, in an attempt to establish the important point of taking successive crops of wheat from the same land ; and judging from the success with which it has been attended, and some other circumstances, I do not entertain the smallest doubt of being completely successful. I shall endeavour to prove, that by this means, the culture of wheat might be extended to two or three millions of quarters per annum *more* than the annual average of imports, during a period of twenty years,—that is, between 1793 and 1812.

If such a change could possibly be effected, we might at all times have a superabundant supply of this most essential article. This superabundance would lead to a reduction of price ; all classes, from the highest to the lowest, would

be benefitted—and the former would derive sufficient advantages, without curtailing the present pittance of the labouring classes. In the course of time, however, the price of labour might fall in proportion to the reduction in the value of bread corn.

In Abstracts, No. V, VI, and VII, page 118, a comparison is made between the regular four-course system, which I have adopted, and two other rotations, by which the culture of wheat would be considerably extended. The computations being applied to 112 acres of arable land, give the following results:—

*Comparison of three Modes of arranging the  
Arable Lands.*

1. One half of the arable in wheat. See Abs. V.
2. One quarter ditto ditto. See Abs. VI.
3. Three-eighths ditto ditto. See Abs. VII.

No.	Proportions in Wheat.	Acres in Wheat.	Value of Produce, per Acre.	Value of Pro- duce from 112 Acres.	Value of Pro- duce from 10 million Acres.
			£	£.	£.
1.	One half	56	8.0	896	80,000,000
2.	One quarter	28	7.5	840	75,000,000
3.	Three-eighths	42	7.88	882	78,800,000

If one half of the arable lands were in wheat, upon an extent of ten million acres, this would

be five million acres—which, at two quarters per acre, would supply ten millions individuals.

If one quarter of the arable lands were in wheat, upon an extent of ten millions acres, this would be 2,500,000 acres—which would supply not more than five millions of the population. This is the defect of the new method, detailed in Abstract XI, which applies also to the old Sussex method, detailed in Abstract X.\*

But, three-eighths of the arable land of the kingdom being in wheat every year, would be in many respects the most advantageous, and the most eligible and practicable to the cultivator ; because, there would be no obstruction to a regular course of cropping ; nor any change or derangement in the equable work of the teams, during the autumn and spring. There would be precisely the same quantity of labour at those two seasons : which would be applied in the manner already mentioned.

By this scheme, there would be 4,200,000 acres in wheat, every year, upon each ten millions acres of tillage land ; and if this were the *established* proportion of wheat culture, upon the arable lands in England and Wales, which have probably been increased from 14 to 15 millions acres, the proportion in wheat, every year,

\* See page 134.

would be one half more, or 2,100,000 acres,—making in all, 6,300,000 ; which would yield a sufficiency for 12,600,000 persons.

Mr. Middleton has estimated, that there are 3,850,000 acres of the 14 millions, in wheat, every year, in England and Wales.\* This proportion applied to 15 millions, gives 4,125,000 for the number of acres annually in wheat; which, at two quarters per acre, would produce not more than sufficient for 8,250,000 persons. This would be inadequate to the demand of the population of Great Britain; for, according to Mr. Colquhoun's statements, in his Treatise on the Wealth, Power, and Resources of Great Britain, it amounts to about 13,800,000.†

\* Abstract, No. IX.

	Persons.
† " Population of Great Britain, 1811 -	11,956,303
Ditto      Ireland, estimated at -	4,500,000
Navy and Army, fed chiefly by the Parent State	640,500
	<hr/> 17,096,803
Estimated increase to the year 1814 -	903,197
	<hr/>
Total persons	18,000,000"

See Treatise on the Wealth, Power, &c. of Great Britain, page 56.

In ten years, from 1801 to 1811, the increase of population was 1,536,000. At this rate, the increase in 8 years, from 1811, would be about 1,220,000—which added to 12,596,803, the amount of population, and Navy and Army, gives 13,816,803 for the total population of Great Britain, in the year 1819.

By the scheme of cultivation, detailed in Abstract, No. VII, page 119—there would be 6,300,000 acres every year in wheat; or a sufficiency for supplying 12,600,000 persons, which are probably more than the number who are in the habit of consuming wheaten bread. In this case, Great Britain would yield a surplus for exportation; or the surplus land, which has been in these computations allotted to wheat, might be appropriated to the purpose of raising hemp, flax, and rape seed, or other articles, for our manufactures, which might give rise to additional sources of employment for a considerable portion of our redundant population.

By a Custom-house document, laid before the Board of Agriculture, it appears, that the average import of all sorts of corn and grain, from 1793 to 1802, was 1,415,229 quarters per annum; and of meal and flour, during the same period, 299,019 cwts.: and from 1803 to 1812, the average import was 1,066,198 quarters, and of meal and flour, 296,850 cwts.

If flour and meal be rated at 3 cwts. to a quarter of wheat, the average import in the first period, was equivalent to 1,514,902 quarters; and during the second, to 1,165,148 per annum. The mean of these sums is 1,340,025—which is the average import per annum, during a period of 20 years.



From these data it may be inferred, that the deficiency of land in cultivation, was 670,012 acres.

It has been deduced from Mr. Middleton's estimate, that there may have been about 4,125,000 acres of the 15 millions in wheat; and that by the scheme proposed, there might be 6,300,000 acres. The difference between these sums is 2,175,000; from which, deducting 670,012, there will remain 1,504,988 acres to be applied to the culture of hemp, flax, rape seed, and other articles, for manufacture and commerce.

It may be proper in this place to remark, that although the system of cultivation I propose, would very much diminish the labour of animals, it would, by bringing the fallows into cultivation, give employment to many more hands, by the weeding, reaping, and threshing of the crops.

The facts which have been disclosed, and the inferences which have been drawn from them, will, I hope, be sufficient to prove, in a satisfactory manner, the practicability of effecting, in many parts of the kingdom, a very great reduction in the present charges of cultivation; as well as a very considerable augmentation in our internal resources,—without adding a single acre to the present extent of tillage land; and at

much less expense than by continuing the present ruinous practice of fallowing.

It will no doubt be perceived, that the plan of cultivation and improvement, which has been suggested, differs essentially from all those which have been hitherto brought forward. It requires neither additional capital, nor additional expense. It might be immediately carried into effect, and the good consequences felt in the short period of one year. Although it embraces three objects of the highest importance to the nation,—that of reducing the expenses of cultivation ; of augmenting the products of the present extent of land in tillage, (thereby increasing the national resources), and of reducing the prices of human food,—yet I hope I have not failed in demonstrating—that the whole of these objects are attainable, without entrenching, in the smallest degree, upon the interests of the proprietor, or the cultivator of the soil.

These objects I conceive to be perfectly practicable,—simply, by reducing the expenses of cultivation ; for, *inasmuch as those expenses can be depressed, so will the value of land be raised :* a proposition so very evident, that it needs no illustration.

Hence I infer, that those proprietors, whose present rents have been raised, by the enormous

prices occasioned during a long period of war, and by the united scarcities of 1800, 1, 10, 11, and 12, (“ which drew from the consumers of corn sixty millions sterling *more* than would have passed into the hands of the proprietors and cultivators, if such scarcities had not taken place”\*) could have no cause to complain, if their present rents were to remain stationary. If such a regulation were made, or spontaneously agreed to, by the proprietors themselves, (which, as it would cost them nothing, no well-wisher to his country could reasonably object to) it would be productive of many essential benefits: and it might possibly avert the necessity of resorting to certain financial arrangements, that have been suggested in a recent publication.

However this may be, it will, I think, hardly be questioned, that a fixed and stationary rent would operate as a stimulus to the farmers,—by giving them an interest in improvements, and thereby inducing them to engage in the most economical modes of cultivation. Moreover, it seems that *fixed* and *steady* rents would have nearly a similar effect to that of long leases; which are well known to conduce greatly to the extension of improvements: and if the exertions

\* See Colquhoun, page 21.—It is probable, that the *extra* sum drawn from the consumers of corn, during these thirteen years, very far exceeded the sum here mentioned.

of the farmers were thus excited, we might naturally expect that those exertions would soon be the means of creating abundance : and that this abundance would regulate the markets in such manner, that the products of the soil might be supplied at much cheaper rates, whilst the farmer might receive a larger profit.

High prices, proceeding from high rents, (or high rents proceeding from high prices,) and expensive cultivation,—have been the principal cause of the distresses of the country. It may therefore be presumed, that low prices of all the necessaries of life, (which would gradually follow cheapness of bread corn) would be productive of an opposite effect.

I have already remarked, that the average price of wheat in 1793, was about 48 shillings per quarter, and in 1814, it was 101 shillings. Let us now suppose, that in 1793 and 1814, there were ten millions of the population supplied from the lands of Great Britain with 10 millions quarters of wheat.

In 1793 the value of those 10 mil-	£
lions of quarters, at 48s. was	24,000,000
In 1814, the value of the same	
quantity, <i>from the same quantity</i>	
<i>of land</i> , was	- 50,500,000
Increased value of wheat in 20 years	<u>£ 26,500,000</u>

This increased value was, in fact, an additional burthen laid upon the consumers—whilst the proprietors and cultivators received that sum, *in addition to their former rents and prices*, for this *single article* of the produce of their lands.

Now, when it is considered, that wheat does not occupy more than a fourth, or fifth, of the land in tillage,—that barley rose from 28 shillings to 50 shillings and 5 pence—oats from 19 shillings to 33 shillings and 5 pence—and that meat, butter, and milk, and all other articles of farm produce, had risen above the prices of 1793, nearly in the same ratio,—some idea may be formed of the immense acquisitions to the landed interests, during the above period: and all this at the expense of every other class of the community.

It is indeed of no consequence to a rich man, whether he pay (I will suppose) 40 shillings or 80 shillings for a quarter of wheat; but to a poor labourer, earning 12 shillings a week, (or £31.4. per annum) the difference is very great. If his family consist of a wife and two children, his annual consumption of wheat may be rated at four quarters, which, at 40 shillings, would cost £8. If the price is 80, they would cost him £16., or more than a half of his earnings—for

this chief ingredient in the food of himself and family ; and when wheat rose to £5. per quarter, his situation must have been truly deplorable,—for he had then to pay £20. per annum, leaving only £11.4. for all his other expenses. It is not surprising then, that he had cause to complain being thus absolutely driven to the necessity of begging his daily bread—by applying to the parish officers.

Taxation is much less an evil to a poor man, than high prices ; indeed, it can scarcely be said to affect him in any degree—consequently, if we can render his daily bread cheap and plenty, we make him contented and happy : for this is undoubtedly the greatest blessing that can be bestowed upon him. It is therefore most earnestly to be desired, that some measures may be speedily adopted, for lowering the prices. If wheat were not considered as the primary crop, in the views of a farmer, the advantage to the country would be great ; for it is most clearly manifested, from what has been just stated, that the high prices of this most necessary article of farm produce, has been the great source of all the distresses : from which, if the labouring classes are not effectually relieved, there can be no hope entertained of solid content, or permanent tranquillity.

A return to low prices can only be effected, by

a wise and judicious system of economy, in every branch of farm management: but if rents were still permitted to rise, in proportion to the reduced expenses of cultivation, things would remain just as they are; and the circumstances of the country would derive no amelioration whatever.\*

I offer these remarks merely as hints, for the consideration of those who are better qualified than myself to contemplate all the various bearings of such a plan of cultivation as I have described.

Writers on political economy have (I believe) generally, if not always, founded their arguments upon the existing expenses of cultivation, without considering the possibility of reducing them. But, if it can be proved, by incontestible facts and experience, that those expenses *are capable of being reduced very far under what they have been*, I conceive that this sort of proof

\* In those parts of the kingdom where rents are extremely low, arising from expensive management, those rents would naturally, and very properly, rise, in proportion to the reduced expenses of cultivation. In such cases, the proprietor ought to participate with the tenant, in the greater profits that may be derived from a less expensive system of cultivation; and thus, the value of low rented farms would be considerably augmented, without enhancing the general cost of productions.

would very materially affect the premises of their arguments, as well as the deductions that have been drawn from them

It may possibly be a wise policy to import wheat, when our own is raised, under the circumstances of the present enormous expenses of cultivation. This seems to be a natural inference, from the items of expense detailed in Abstract, No. I; by which it is clearly shewn, that upon each hundred acres of arable land, managed according to the old system, *there is no gain whatever to the farmer*. The expenses of his fallow, of labour, and lime, are so enormous, that he would be utterly ruined, if it were not for some small profit, arising from the other parts of his farm, which he holds, with the rest, at the very low rent of 15 shillings per acre.

But, under such a system of economical management, as that detailed in Abstract, No. II, it is shewn, that *there is a profit to the farmer of £350. per annum, upon each hundred acres of arable land*: which, if applicable to 10 millions of acres, would be an accession of 35 millions sterling, per annum, to the farmers, and to the wealth of the nation. Surely then, so vast a difference in the two methods of cultivation, cannot fail to give a totally different direction to the views that have been taken of the important



question—whether Great Britain should, or should not, remain dependent on foreign nations, for a portion of her supplies of bread corn.

These, however, are matters more properly belonging to the economist than the farmer. The task I had undertaken, was to point out the means by which a farmer might economise in some of the most material branches of his operations. This indeed is a subject to which little or no attention has hitherto been paid,—although it be one in which every member of the community is deeply interested: for upon the good or bad management of the farmers, must ultimately depend the prices at which they can afford to sell their productions.

Upon the whole, it appears to me, that the state of our agricultural management is a subject most intimately connected with the prosperity and welfare of the nation,—and therefore, deserving the most serious attention of his Majesty's Government. If all the errors and imperfections of husbandry were ascertained and corrected; and if a general system of economy and improvement in agriculture, pervaded the whole kingdom,—the advantages would be incalculable; for I am disposed to believe, that there is no other source from which so many substantial and permanent benefits might be de-

rived, nor from which the existing circumstances of this country are more likely to be permanently and effectually relieved and improved, than by using every practicable means to advance this most useful, most necessary, and most important art, to the highest perfection of which it is capable.

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## APPENDIX.

## ON IMPLEMENTS.

At what period the practice of deep ploughing, and of reversing or turning over the soil, was introduced into Britain, and some of the northern parts of Europe, by means of ploughs, of greater strength and power than those in use in the early ages, is probably uncertain. It is obvious, however, that these changes (which must have been subsequent to the Norman invasion,\*) have added very considerably to the labour and expense of preparing the land for the seed.

The principal object of ploughing, is to divide the soil into small particles, for the purpose of admitting into its pores, moisture, air, heat, and light, which are the great and indispensable agents of vegetation. I have shewn, by several facts, stated in the 4th Section, that this openness of the soil is much more perfectly, more easily, and more expeditiously accomplished, by implements of small power, without reversing or turning: and I have also shewn, that I have found it advantageous to adopt the principles of the ancient ploughs, and of those at present in use amongst the Indians and Chinese; which are all calculated to produce precisely the same effect:—that is, to break and crumble the soil without turning it. This is indeed the only effect that Indian ploughs can

\* See note, page 19.

produce; which must appear evident, from the representations given in Plate IV. Similar to this (at least nearly) is the effect of the Chinese plough: of which there is a good representation in the *Farmer's Magazine* for 1805.

The *araire*, used in the southern departments of France, is supposed to be of the form and construction of the ancient Roman plough. It acts differently from the Indian and Chinese ploughs; and is constructed, in some respects, upon the principles of the *binot* of France and the Netherlands,—which raises the land without turning it.\*

From all these facts, it may be fairly inferred, that a vast portion of the globe is cultivated in a manner totally different from that which has gradually found its way into these kingdoms; and yet we hear no complaints of the defectiveness of implements. Every nation is apt to think its own mode of cultivation the best. The Chinese, it is said, would laugh at our ploughs, as much as an English farmer would laugh at theirs.† Let us fairly understand the merits of both. Let us examine and compare their modes of preparing the soil with our own: and if theirs should be equally effectual, and less laborious, this would at once decide the question at issue, between us and the Chinese.

I hope that these observations may induce some intelligent cultivators to give a trial to the two methods of preparation,—the one, by ploughing deep and reversing the soil,—and the other, by breaking and crumbling it by repeated operations.

The implement which I make use of for this latter purpose, is represented by Fig. 1, Plate I. The Plan and

\* See page 75.

† See page 45.

Elevations being accurately drawn, according to the scale, will sufficiently explain its several parts. All that is necessary to add, is, that the frame is of ash, and the dimensions of the several pieces 3 inches broad, by  $3\frac{1}{2}$  inches deep. Pieces of bar iron, with square holes for admitting the upper part of the tines, are placed along the upper parts of the two bars, which greatly strengthen them, as well as the frame. The oblique pieces of wood, passing from the extremes of the hind bar towards the wheel, are 3 inches broad and  $\frac{3}{4}$  inch thick. The tines are of bar iron,  $1\frac{1}{2}$  inch broad and  $\frac{3}{4}$  inch thick. The points of the tines which enter the soil are steeled; and they are firmly fitted into the frames with screws and nuts. The length of the tines is 10 inches from the under part of the frame. The draught may be either from the fore part of the scarifier, near the wheel, or in the manner represented in the side elevation.

This frame, which combines strength with neatness, is adapted to a variety of agricultural purposes. By changing the form and position of the tines, and by introducing small shares and coulter, upon semicircular frames of wood, (one inch in thickness, and strengthened with a cross bar on each side) and fixed in the manner represented in Fig. No. 5 and 6, Plate II, it can be transformed into the following implements; and can perform a variety of operations, with the power of one horse, at the rate of 3 acres per day, or at 20 pence per acre.

1. Scarifier,—for pulverizing the soil.
2. Horse Hoe,—for hoeing three rows of corn, 9 inches apart.  
Explained in Plate I.
3. Meadow Slicer,—as represented in No. 6, Plate II. By having a sharp coulter in the front of each semicircle, and with-or without the small curved share, (represented by the thick black line on the left) it makes four incisions in the meadow, for the admission of manure.

4. Stubble Rake.—By taking out all the tines, and bolting, with 2 screws and 2 nuts, upon the hind piece of the frame, a bar of wood containing 8 or 9 teeth, like those in Fig. 2. Plate II, it becomes an excellent rake.
5. Machine,—for placing broad-casted corn in rows. Fig. 5, Plate II.
6. Ditto, ditto turnips, beans, or peas, in rows, 27 inches asunder: two sets of mould boards, one at each side of the frame, convert it to this purpose.
7. Ditto,—for hoeing turnips, beans, or peas, in rows, 27 inches asunder.

Besides the purposes above enumerated, the same frame would admit of the coulter and shares of any description of plough.

It is unnecessary to say more respecting the construction of the implements, as the descriptions in page 53 to 58, and the Figures, No. 1 to 6, will, I hope, be sufficiently intelligible, for enabling any village carpenter and smith to make them. But, in regard to the scarifiers, and the diminution of labour, in preparing the lands for the seed, which would result from their being generally substituted for the plough, I deem it proper to offer a few observations, in addition to those already stated in the 4th Section.

It has been justly observed by a French writer, that the plough is not the implement the best suited to the purpose for which it is intended,—because it is not that which is the best for dividing the soil. The greatest perfection, says he, that could be given to it, would be “to render it more expeditious: and to make it produce effects similar to those of the spade and hoe.”

This slowness of operation is indeed a defect in every species of plough. Even an English plough, taking at once only 9 inches in breadth, must pass over at least  $12\frac{1}{2}$  miles in ploughing one acre: and when four horses

are employed in drawing it, the journeys of these four horses, considered separately, will amount to fifty miles, in ploughing the acre once over; consequently, in ploughing it four times, the spaces passed over by the four horses collectively, will amount to two hundred miles: and after all, this acre will be left in a rough and cloddy state,—requiring both harrowing and rolling, before it is in a condition to receive the seed.

But, if a single horse scarifier, which takes a breadth of 27 inches, had been used instead of the plough, this acre would have been in a fine state of preparation for the seed,—and with even *less* than one-eighth of the power that had been bestowed upon it by the four ploughings.

To illustrate this position, I will suppose that *six* scarifyings are necessary (although my stiff lands have only *four*) for completing the pulverization:—this would be the work of two scarifiers for one day. Now, as each horse in the scarifier travels the same distance per day, as each horse in the plough,—that is,  $12\frac{1}{2}$  miles, it is obvious, that the two horses, collectively, must have travelled only 25 miles in perfectly pulverizing an acre.

This result of one-eighth of the animal labour, that was expended in ploughing, being sufficient in preparing an acre with the scarifier, is confirmed and clearly made out, by simply multiplying the 4 horses used in the plough, by 4 days labour, which gives 16; and by multiplying the one horse in the scarifier, by two days labour, which gives two; or only one-eighth of the animal labour expended in ploughing.

In ploughing an acre four times, (according to the practice in summer fallowing) the manual labour ex-

pended is that of one man and a boy for four days; or,  $2 \times 4 = 8$  days labour of one person: but in scarifying an acre six times over, and obtaining a perfect pulverization, the manual labour expended, is that of one man and a boy for two days; or,  $2 \times 2 = 4$  days labour for one person. Hence it is proved, that although the *animal labour* is diminished, in this new method of preparing land for the seed, in the ratio of 8 to 1,—yet the *manual labour* is diminished only in the ratio of 2 to 1.

These views of the matters in question, clearly demonstrate the vast utility of the scarifier, and its superiority to the plough in preparing land for the seed: and more especially, as it *produces effects similar to those of the spade and hoe*, by mincing and crumbling the land into small particles.

#### ON CLAY-KILNS.

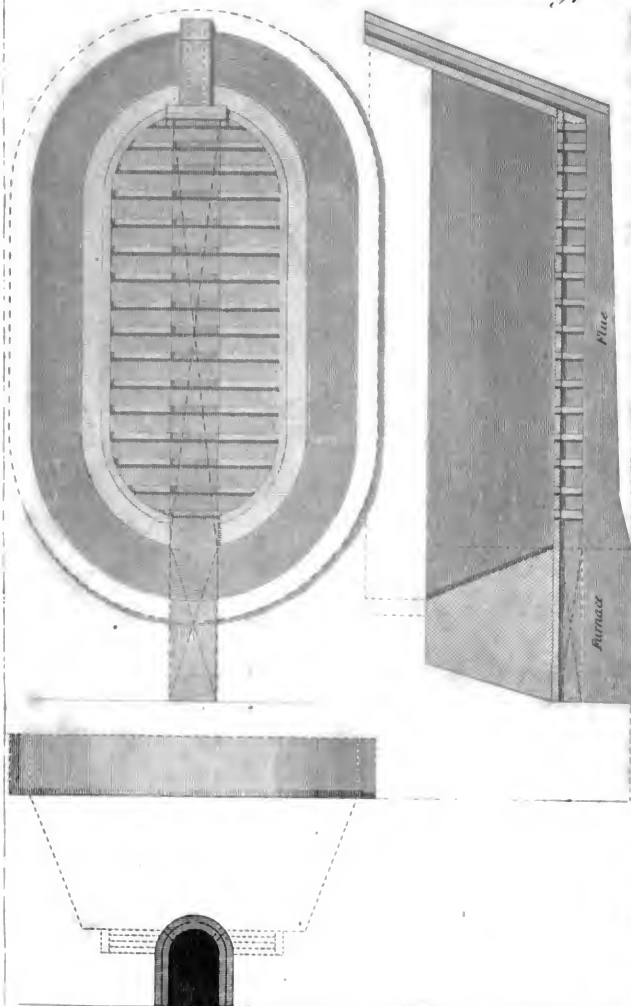
THE importance of calcined clay, stiff soil, or marle, as a cheap and valuable manure, and a substitute for lime or dung, has, I hope, been sufficiently established by the facts adduced in the preceding pages. To calcine those materials in the cheapest manner, was therefore an object deserving attention; for, although the utility of calcined clay in agriculture had long since been known, both in England and Scotland, yet it fell into disuse, until within these few years, on account of the expensive mode of burning, which rendered it too costly—notwithstanding its efficacy as a manure, had been ascertained to be even superior to lime or dung.

The form and construction of the kilns which I make use of for burning, may be fully comprehended by the Plan, Elevation, and Section, in Plate III. The grid-



CLAY KILN.

*This kiln burns 250 cart loads of 10 bushels, at one shilling per load.*



*Elevation of the breast of kiln — shewing the transverse section.*

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iron floor, formed by the transverse flues, which convey the heated air immediately under the clay, has been found necessary in kilns of large dimensions. In smaller kilns these lateral flues may be dispensed with. An open arch flue, passing from the furnace to the back of the kiln, of the same dimensions as in the plan, and having a chimney at the farther part, has been found to answer extremely well, in kilns that contain from 80 to 120 cart loads.

The site of the kilns should be chosen as near as possible to the materials that are to be calcined. Whether the material be clay, stiff soil, or marle, it will save expense if it can be ploughed. The slags should be large. They are then cut with the spade, and carted, or carried in wheel barrows, to the kiln, if the distance be short. This latter mode is advisable, as it saves the labour of cattle or horses.

The best situations for the kilns, are steep sloping banks of clay, or stiff land, in which the furnace can be placed low: this is a very material point; because, the lower the furnace, the deeper may be the excavation of the body of the kiln, and the more capacious it may be made.

When the site of the kiln is determined on, the surface ground should be smoothed or levelled, and the upper dimensions of the kiln accurately traced. The body of the kiln is then excavated,—the sides and ends gradually sloping in the manner represented by the dotted lines in the

\* A kiln of the dimensions represented in Plate III. requires about 3000 bricks. Mud mortar is used. The expense of building the furnace, flues, &c. is about 10*l.* or 12*l.*

*Elevation of the breast of kiln*, Plate III. When the excavation has been completed to the intended depth, (leaving sufficient depth for the furnace and flue), the floor of the kiln is also levelled or smoothed; and the furnace and flue, from the breast to the back of the kiln, traced on the floor, and excavated perpendicularly. This trench, or flue, has a gradual declination from the back part, or chimney, for the purpose of letting off water: the inside is lined with bricks placed lengthwise. These two walls,  $4\frac{1}{2}$  inches thick, form the pier or support of the open arch, which is made with arch bricks, laid also lengthwise; so that each arch is nine inches broad, leaving open intervals of  $4\frac{1}{2}$  inches. In a line with these intervals, the lateral flues are made in the manner represented in the Plan and Elevation. The dimensions of all the parts of the kiln, may be measured upon the scale.

The open arch should have three *ties*, or a continuation of bricks,—one along the key, or centre,—and the other two along the sides, at half the distance between the key and the spring of the arch. These ties render the whole of the open arch firm and strong, and not liable to be deranged by the heavy load of clay, which is to be laid upon it.

At first, the clay is laid on carefully in large pieces, leaving wide interstices, for the admission of heated air, all along the arch of the flue, and the lateral flues. When the clay has covered these, to the height of 2 or 3 feet, it may then be thrown into the kiln. The largest pieces are put in at first, and the smaller reserved for the upper covering. The clay should be rather in a moist state,

because, if laid on when too dry, it is apt to become hard by the heat: but if damp or moist, the whole mass becomes in a manner steamed, and calcines into a light porous substance, which easily pulverizes upon being exposed to air and moisture. A cart load, or 16 bushels, of moist clay, weighs about 1500 pounds; and when it is calcined, the weight is reduced to 1200.

Sometimes I have used, for fuel, large roots in a rough state, worth not more than 4 shillings a cord; and sometimes kiln faggots, of the value of 4 shillings per 100. With these faggots I made an accurate experiment, in a small kiln, (21 feet by 9) having a furnace, and an open arch flue. The result was, that with 275 faggots, and half a cord of roots, 80 cart loads (or 1200 bushels) were completely calcined, at an expense of only 13 shillings for fuel,—or less than 2 pence per cart load. The whole expense, including labour, was 10½ pence per cart load.

But, the least expensive method of procuring an abundant supply of manure for a stiff land farm, is by paring and burning. I have not yet perceived, that the effect of clay or marle ashes is superior to that of turf or soil. In the autumn 1818, I manured part of a field of eight acres, with the ashes of stiff soil burnt in a kiln, and a part with clay ashes,—at the rate of 20 cart loads of each per acre. The whole field was drilled with wheat: the crop was excellent: no difference was perceptible during the growth, nor at the time of reaping. This experiment determined me to pare and burn a mossy worn-out pasture of 6½ acres. Instead of Denshiring, the Scotch plough was used; and the whole was pared to

the depth of  $3\frac{1}{2}$  inches. It was then cross ploughed in such a manner, that the sods were about 2 or 3 feet long. These, when dry, were burnt in various ways; some in small heaps, but owing to the sods being damp, they did not succeed. Heaps of 4 or 5 cart loads were tried; but the force of the fires being insufficient, they were soon extinguished. Circular heaps, formed over large roots, were completely successful: and finally, some of the clumps were made 54 feet in length, by 20; which were found by far the best.

The manner of forming these clumps was thus;—a quantity of large roots, 45 feet by 12, was laid upon the ground, and inclosed by a wall of sods, 3 or 4 feet high, and 54 in length by 20; at the bottom of each side wall were six openings, about 20 inches square, in which faggots were laid, so as to connect with the roots. When the inclosure was filled with sods, and the clamp raised to the height of 8 feet, the twelve fires were all kindled at the same time; and in less than 48 hours, the whole mass, containing 400 cart loads, was entirely burnt through to the top. By this mode of burning, I have computed, that the ashes cost not more than three-pence per cart load, of 16 bushels; and that this field of  $6\frac{1}{2}$  acres, will yield between 4 and 5000 cart loads: of which about 1000 loads have been laid upon the adjoining arable and meadow lands; and the remainder left on the field for a crop of barley.

It is by such means, that many farmers, by abandoning prejudices and expensive manures, might soon cultivate their lands at a much cheaper rate, than by sending upwards of twenty miles for lime.

Mr. Boys, of Betsanger, in his Survey of Kent, has placed the advantages of paring and burning in so conspicuous a point of view, that it is really surprising it should still have opponents,—from an idea, that burning the surface will, in the end, impoverish the land. Even supposing this to be the fact, the impoverishment might easily be remedied, by the application of 20 or 30 cart loads of ashes per acre, occasionally, from the clay-kilns.

### ON EXPERIMENTS.

HAVING, in pages 29 and 83, fully explained the circumstances of four small experiments, which may be justly considered as the origin of my present mode of cultivation: and having most clearly established, not only by my own experience, but by several respectable authorities referred to,\* that *the system of surface soil, and clay burning, is a most important discovery for the interests of agriculture*,—it would be wholly superfluous to say more, or to detail experiments, which could answer no other purpose than to lengthen this report, already too much extended. I shall therefore conclude with the following Table, which will give the reader an idea of the manner in which the experiments have been conducted.

\* Pages 106—110.

## COMPARATIVE EXPERIMENTS.

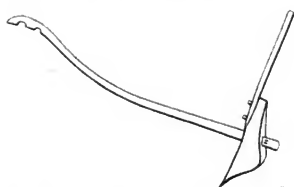
*Drilling and Broad-casting Wheat on various Manures.*

	Cart loads manure, per acre.	Drilled.		Broad cast.		Drilled.			
		4 pecks seed	6 pecks.	4 pecks.	10 pecks.	6 pecks.	6 pecks.	4 pecks.	2 pecks.
No manure <i>a</i>	—	1 11	2 19	3 18	4 19	5 10	6 19	7 12	8 6 <i>a</i>
Lime <i>b</i>	—	9 * 15	10 * 25	11 * 22	12 22	13 10	14 15	15 13	16 5 <i>b</i>
Clay ashes <i>c</i>	2½	17 15	18 25	19 24	20 25	21 11	22 13	23 5	24 3 <i>c</i>
Clay ashes <i>d</i>	5	25 23	26 26	27 21	28 24	29 12	30 11	31 5	32 2 <i>d</i>
Clay ashes <i>e</i>	10	33 23	34 28	35 22	36 25	37 12	38 12	39 5	40 4 <i>e</i>
Clay ashes <i>f</i>	20	41 22	42 23	43 18	44 22	45 13	46 15	47 10	48 6 <i>f</i>
Clay ashes <i>g</i>	30	49 19	50 26	51 21	52 24	53 15	54 15	55 10	56 7 <i>g</i>
Clay ashes <i>h</i>	40	57 18	58 20	59 21	60 19	61 10	62 10	63 9	64 7 <i>h</i>
Rot dung <i>i</i>	40	65 12	66 17	67 20	68 19	69 15	70 13	71 12	72 8 <i>i</i>
Rot dung <i>k</i>	60	73 10	74 18	75 14	76 18	77 14	78 16	79 14	80 8 <i>k</i>
Wood ashes <i>l</i>	10	81 18	82 21	83 15	84 15	85 10	86 14	87 10	88 10 <i>l</i>
Wood ashes <i>m</i>	20	89 13	90 23	91 9	92 14	93 13	94 13	95 10	96 10 <i>m</i>
Raw marle blue <i>n</i>	80	97 15	98 21	99 14	100 15	101 10	102 13	103 12	104 9 <i>n</i>
Shell marle <i>o</i>	40	105 17	106 22	107 19	108 22	109 15	110 18	111 14	112 10 <i>o</i>
Shell marle <i>p</i>	60	113 22	114 27	115 28	116 27	117 27	118 25	119 22	120 12 <i>p</i>
Clay ash & peat dust <i>q</i>	40	121 20	122 23	123 26	124 31	125 25	126 22	127 16	128 18 <i>q</i>

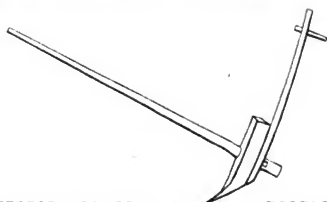




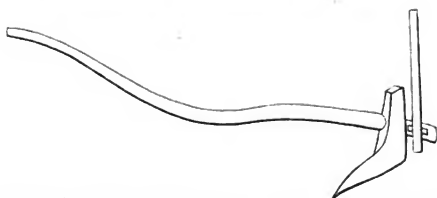
PLOUGH OF MANGALORE.



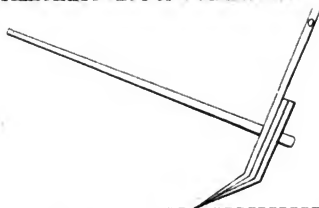
PLOUGH OF BANAWASSI, IN CANARA.



PLOUGH OF IMANGULA IN MYSORE.



PLOUGH OF PALIGHAT, WEST OF COIMBATORE.



The experiments are numbered from 1 to 128. The dimensions of each were intended to be a rod square; but the longitudinal and transverse furrows reduced them to 15 feet. The produce, in straw and ears, from each number, on the day of reaping, is entered in avoirdupoise pounds: for example,—No 1 yielded 11 pounds; No. 2 yielded 19; and so on.

The several manures, in the proportions specified in the first column, were laid in the direction of the letters; thus c,c, or the numbers 17 to 24, had at the rate of  $2\frac{1}{2}$  cart loads of clay ashes per acre; and in the same manner e,e, had 10 cart loads, or 160 bushels per acre.

No. 9—was dressed with  $\frac{1}{2}$  a bushel of lime, or 80 bushels per acre.

10— $\frac{1}{4}$  bushel of lime, or 120 bushels per acre.

11—1 bushel of lime, or 160 ditto ditto.

After the several manures were spread, the land was scarified in the direction of the letters *a,a, b,b, &c.*; so as to incorporate the manures with the soil. The wheat was then drilled and broad casted, in the direction of the vertical columns, or of the numbers 1—121; 2—122; &c. But, as the season was wet, and the seed was put in late, (that is, in November,) and as the surface of the land sloped from “No manure” to “clay ash and peat dust,” these unfavourable circumstances have caused a very considerable disagreement, or discrepancy, in the results. I have entered the above table, more with a view of shewing the methods I use for making comparative experiments, than for shewing with accuracy the relative results.

FINIS.













